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## SELECTION WORK IN CEYLON PADDIES.

In the February number of the TROPICAL AGRICULTURIST for 1921 was included a paper on the tillering of paddy. This paper was the outcome of work begun on the scientific investigation of Ceylon paddy varieties with a view to improving varieties under cultivation.

In the present number are given further details which were recently presented to the Food Products Committee of the Board of Agriculture on this important work of the improvement of Ceylon paddies.

Work continues to be carried on at Anuradhapura which is the main station for paddy selection work and duplicate investigations are being carried out at Peradeniya on a smaller scale.

During the Yala season it was possible to commence variety trials on a fair scale with a small number of the earlier selects, but during the present Maha season only small areas could be dealt with. Some very promising varieties are being evolved, and at the end of next season some quantities of pure seed should be available for distribution to selected cultivators for further testing.

During these experiments it has been clearly demonstrated that for large yields of paddy thorough cultivation must be carried out during the proper season. The true agricultural sense is apparently being lost in many parts of the Colony. Cultivation is being carried out at irregular seasons and the results are not as satisfactory as they should be. The effect that cultivation at the proper season has upon yields is most marked in some crops and paddy does not appear to be the exception,

At Anuradhapura, particular attention has been paid during the Maha season to cultivation and the present crops of pure-line paddies justify the additional work that has been put into the preliminary preparation of the land.

The varieties being cultivated give promise of yielding greatly increased crops. It is upon increased crops that Ceylon must depend if it is to become more self-supporting in its requirements of rice. The use of better varieties of seed is one means of ensuring increased crops and when these varieties have been secured it remains only to have them tested carefully and thoroughly in various parts of the Colony and then to arrange for their satisfactory distribution. It is more than probable that these varieties will not suit all localities. This, experience alone can show.

There are localities that demand special types of paddies for cultivation and it is not expected that these special problems can be undertaken at the outset. The results of the present work will indicate the directions in which extensions will have to take place, and what other varieties of paddy should be worked upon after the present varieties have been satisfactorily dealt with.

Enormous improvements have been made in varieties of cereals in temperate climates in the past few years both by private enterprise as well as by the result of official undertakings. In India, marked strides have already been made, and in most countries dependent upon rice as its main food, work has already been begun on the various and different paddies.

Paddy growers should be encouraged to keep in touch with the work at present being undertaken in Ceylon, for during the next step in the evolution of pure strains comparative tests in different districts of the Colony will be required to be made. The difficulty to find adequate land for the comparative tests will be a real one and the assistance of the larger paddy growers will have to be sought.

After the next season's crops limited supplies of pure line strains of seed will be available for experimental trial and testing.

# RICE.

## THE IMPROVEMENT OF CEYLON PADDIES.

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I have been asked by the Director of Agriculture to prepare, for your information, a statement of the progress in the Division of Economic Botany with regard to the possible improvement in yield of Ceylon Paddies. The Division, as at present constituted, deals almost solely with Paddy, and the policy adopted by MR. SUMMERS, the former Economic Botanist, and continued by myself, consists in extracting from the heterogenous collection of Paddies now grown in the Island, a few types which may be expected to give higher yields under normal conditions. The problem of establishing the best method of gaining this result is complex, but a study of methods of attack by workers in other countries points to Pure Line selection as the surest way.

The goiya gives a name to his Paddy, and considers it a type. A very cursory botanical study will invariably show that this so called type actually consists of a number of types, and if an ear of each is then grown in beds, side by side, a variety of differences will be noticed amongst the growing plants. One bed of plants may stool well; another may be long and wiry; one may be bearded; another beardless; and so on. If these plot tests are kept on in areas small enough for detailed observation, and any plants that are not true to type are rigorously destroyed, the result is a series of Pure Line cultures, whose performances can be accurately compared. This, in short, is the method in vogue at the two Government Experiment Stations at Anuradhapura, in the Dry Zone, and Peradeniya, in the hill country. There are, of course, many points to be considered in such Pure Line selection but at the moment it is my desire to give you an idea of the results that may be expected.

A representative collection of Ceylon paddies was made by the Department of Agriculture in 1919, and these were laid down, and Pure Line selections extracted from them, by the former Economic Botanist. The number was far too great to allow of individual attention, and rigid cuts on a basis of yield were made. In the Maha season 1919-20, 105 kinds of 6 months paddies, and 272 kinds of 4 and 5 months paddies were transplanted at Anuradhapura, a smaller number being put in at Peradeniya. From these, a vast collection of Pure Lines could have been evolved, but an army of workers would have been necessary. For convenience, an arbitrary grouping into Mawi and Samba paddies was adopted, and in the Maha season 1920-21, 421 Pure Lines of Mawi and 155 Pure Lines of Samba—of different varietal extraction—were transplanted at Anuradhapura. Some very encouraging results were found, and for Maha 1921-22 I have selected 45 Pure

Lines of Mawi and 7 Pure Lines of Samba which have been put in at Anuradhapura. The stage has now been reached to try these selections on a comparative basis, and a series of plots of standard size in fields of equal area has been transplanted at the Dry Zone Experiment Station. Each of the 52 Lines mentioned above is repeated 8 times in plots of 4 ft. 6 in. by 40 ft. 6 in. (roughly 1/250 acre.) The plants are spaced accurately at the corners of 6 inch squares, and a 3 ft. alley way runs between contiguous beds. By this means, it is hoped to minimise the effect of soil difference, and to gain a fair comparison of the yield performances of the 52 selections. The yield figures calculated from the harvest of March-April 1921 show returns of 73 to 173 bushels per acre for these Lines. If the outstanding yield of 173 bushels is approached again this year, it will have warranted the adoption of Pure Line selection as a basis for improvement. This is a type extracted from a Kohu Mawi (Brown Awned Paddy, with red seed coat) from the Central Province.

A few details of yields may be interesting. It must be remembered that these figures are calculated from small areas, and must not be taken as being possible of realisation over large areas. They are, however, comparative.

| | | | *Calculated* |
|---|---|---|---|
| *Mawi* group. | | | |
| Kohu Mawi | ... | from C. P. | Yield 129·7 b/a |
| Kuru Mawi | ... | ,, W. P. | 96·3 b/a |
| Kalukan Mawi | .. | ,, W. P. | 101·6 b/a |
| Sudu Mawi | ... | ,, W. P. | 157·8 b/a |
| Maha Mawi | ... | ,, W. P. | 115·1 b/a |
| Mawi | ... | ,, W. P. | 123·4 b/a |
| Sudu Mawi | ... | ,, C. P. | 116·8 b/a |
| Maha Mawi | ... | ,, S. P. | 166·9 b/a |
| Goda Mawi | ... | ,, S. P. | 121·0 b/a |
| Kohu Mawi | ... | ,, N. C. P. | 104·5 b/a |
| Kohu Mawi | ... | ,, N. C. P. | 125·5 b/a |
| Sudu Mawi | .. | ,, N. W. P. | 127·2 b/a |
| Maha Mawi | ... | ,, N. W. P. | 89·3 b/a |
| Ratkundu Mawi | ... | ,, Sab. | 86·1 b/a |
| Mawi | ... | ,, C. P. | 107·9 b/a |
| Sudu Mawi | ... | ,, Sab. | 121·2 b/a |
| Mawi | ... | ,, N. W. P. | 120·0 b/a |
| *Samba* group | | | |
| Podi Wi | ... | ,, W. P. | 94·6 b/a |
| Kurulutuduwi | ... | ,, W. P. | 75·5 b/a |
| Muttu Manikkan | ... | ,, W. P. | 79·1 b/a |
| Molagusamba Wi | ... | ,, W. P. | 76·2 b/a |
| Ranmanikkan | ... | ,, W. P. | 72·6 b/a |
| Puluk Samba Wi | ... | ,, W. P. | 86·3 b/a |
| Sura Samba | ... | ,, W. P. | 101·2 b/a |

At Peradeniya, the progress has been hampered by the effect of local conditions. It is not always possible, when experimenting with paddies from other areas, to strike the optimal period for sowing. Some of the varieties tried have suffered from being sown out of season, and others are not suited to soil conditions. Some few lines show definite promise for

this district, and the policy of trying larger numbers of varieties and eliminating the failures has been adopted. Comparative plots have been laid down just as at Anuradhapura and control plots of local Hatiel are transplanted alongside.

Turning, now, to the shorter aged paddies, a similar line of attack has been carried through. It is not necessary to detail the steps, as, *mutatis mutandis*, what is true of the long age trials holds for the short age trials also. During this last Yala season at Anuradhapura selected Lines from the following main groups were transplanted, viz :—Bala Wi, Danahala, Ilkanalayan, Murunkan, Heenati, Suwanda-el, Suduhatiel, Kalupanniti, and Madoluwa, totalling 449 Lines at the Dry Zone Experiment Station, and, 238 Lines at the Experiment Station, Peradeniya. In addition, some 8 Lines were tried out on a larger scale at the Dry Zone Experiment Station for multiplication of seed.

A few of the outstanding Lines in each group are given here, so that an idea may be gained of the progress that is being made.

| | | | | | |
|---|---|---|---|---|---|
| *Bala Wi* group | | | | | |
| Sudu Bala Wi | from Uva | ... | Age 117 days | Yield 55·5 | b/a calcd. |
| Bala Kera | from Galle Dist. | ... | 160 days | 53·7 | ,, |
| *Danahala* group | | | | | |
| Danahala | (unknown origin) | ... | 113 days | 100·7 | ,, |
| do | do | ... | 124 | 56·85 | ,, |
| Danahala | Matale Dist. | ... | 124 | 55·5 | ,, |
| *Heenati* group | | | | | |
| Hinati | (unknown origin) | ... | 122 days | 120·0 | ,, |
| Heenati Wi | C. Prov. | ... | 154 ,, | 132·3 | ,, |
| Hinati | (unknown origin) | ... | 138 ,, | 101·4 | ,, |
| Podi Hinati | W. P. | . | 138 ,, | 89·5 | ,, |
| Sudu Hinati | N. W. P. | ... | 152 ,, | 87·1 | ,, |
| Seenaddy | N. P. | ... | 124 ,, | 74·25 | ,, |
| *Ilankalayan* group | | | | | |
| Ilankalayan | (unknown origin) | ... | 154 ,, | 68·2 | ,, |
| do | do | ... | 135 ,, | 65·3 | ,, |
| *Murunkan* group | | | | | |
| Sinne Murungan | N. P. | ... | 171 ,, | 91·7 | |
| Murungan | N. P. | ... | 115 ,, | 62·4 | ,, |

The other groups were badly attacked by fly. It was only necessary to see the standing crop to realise that they are capable of doing much better than the following results would indicate.

| | | | | | |
|---|---|---|---|---|---|
| Suwanda-el | Plot | label K—s—2 | 157 days | 91·71 b/a | (avrge of 3 plots) |
| do | do | J—s—1 | 155 | 58·5 | (avrge of 4 plots) |
| do | do | N—s | 157 | 57·75 | (avrge of 6 plots) |
| Madoluwa | do | D—s—1 | 159 | 65·5 | (avrge of 4 plots) one giving 93·4) |
| do | do | B—s—3 | 160 | 65·4 | (avrge of 4 plots) |

The above were grown in comparative plots. From the Pure Line cultures of the same varieties come the following figures —

| | | | | | |
|---|---|---|---|---|---|
| Suduhatiel | ... | NN 2/8 | 161 | ... | 67·5 |
| do | ... | NN 2/6 | 171 | ... | 64·6 |
| Suwanda-el | ... | N/5 | 156 | ... | 88·5 |
| do | ... | K 2/s | 161 | ... | 72·8 |

The quantity of empty and fly-sucked grain throughout the plots is a great disappointment. The neighbouring villagers take no steps to destroy the fly which breeds rapidly, and spreads over our crops. Despite the bad season, Lines can be chosen from the above list which show promise of an improved yield, provided that they will maintain their present standard. They will be repeated next Yala for this purpose. Such a table of results must be accepted with caution by residents in districts removed from the two Government Experiment Stations at Anuradhapura and Peradeniya. The stability of the above yields will be checked over larger areas in the Maha and next Yala seasons, but it is not safe to assume that selected paddies which promise well at these centres will necessarily succeed in other parts of the Island. A system of small experimental areas distributed amongst the larger paddy growing areas of the Colony is required before reliable seed can be raised for other districts. A beginning has been made in this direction, and one planter in the Kalutara district has offered to co-operate in trying out certain Pure Lines for suitability in that area during the next Yala season. It is hoped that other such offers may be forthcoming, and they would be particularly welcome from, or through, members of the various Food Production Committees. Areas of any size from half an acre upwards would provide valuable ground for these local trials, and it is hoped that this appeal for co-operation with the Department of Agriculture will merit the serious consideration of this Committee.

In conclusion, then, work is in progress on sections from varieties in the groups

Mawi
Samba
Bala Wi
Danahala
Hinati
Ilankalayan
Murunkan
Suwanda-el
Kalupanniti
Suduhatiel
Madoluwa

Two other varieties have been put down for consideration this Maha, viz., Hatiel at Peradeniya, and Tillenayakam at Anuradhapura. It is hoped, gradually, to include other strains such as Dewereddiri, Sulai, Perunellu, Hondarawala, Suduwi, etc. Some work was done, on these varieties, in 1919-20, but it was found impossible to deal successfully with so many varieties at once, and the selection work was postponed. It is hoped also to experiment with hill paddy, and to include such considerations as yield of straw, etc. A collection of salt and flood-resisting types has been made for varietal trial. All these must be considered, for the present, as side lines to be worked at if, or when, time and labour permit.

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*Paper read before the Food Products Committee at their meeting at Colombo on December 14th, 1921.*

# COFFEE.

## ROBUSTA CULTIVATION AND ITS POSSIBILITIES.

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I.

*History.*—The early history of Coffee is involved in considerable obscurity. As far as can be ascertained, it was not known to the ancients. No mention of the plant or its product is to be found among the Egyptians in the time of the Pharoahs. Nor was it known to the Greeks or Romans; and although claimed to have been in use among the Arabs at a very remote time, no reference is made to it in the Koran of Mohammet. To the Ethiopeans, its use is said to have been known from time immemorial and that the plant and its virtues were first discovered in their country is now generally admitted. From Ethiopia, it was introduced to Abyssinia somewhere in the early part of the 8th century, and from thence to Arabia. As time went on, it became a popular beverage in Egypt and its progress from there to Turkey (at that time a dependency of Egypt) and the adjoining countries, Asiatic as well as European, was easy and rapid. Its peculiar property of dissipating drowsiness and hindering sleep was taken full advantage of, by the early Mohommetans, who welcomed the assistance of this delightful beverage in their prolonged religious services. It is interesting to note in passing that at about the end of the 16th century—so it is said on high authority—a refusal to supply a wife with a specified quantity of coffee was considered a sufficient ground for divorce in Turkey. Coffee drinking habit thus spread rapidly and has now become practically a universal one. The fame of coffee houses in European countries is well known as popular resorts of fashion and learning, where opinions are freely exchanged and wits bandied over cups of steaming coffee.

*Ceylon.*—Coffee was first introduced into Ceylon by the Dutch Government in the early part of the 17th century. The rulers of that period took immense trouble to induce the people to take to this cultivation and laboured hard to establish this as a permanent produce in this country. Their efforts were not in vain and memoirs left by the Dutch Governor SCHREWDER show that Ceylon was able to produce as much as 100,000 lb. of coffee in the year 1739. Later, as it was found impossible to maintain prices here, owing to the large supplies from Java, the cultivation was neglected. After the advent of the British, coffee engaged the attention of GENERAL BARNES, Governor of Ceylon (1824-1830), who was convinced that, if successfully grown, it would prove a mine of wealth to the colony. The reviving of coffee cultivation was entirely due to his initiative, zeal and enthusiasm. He spared no pains to encourage and push forward this enterprise and by his untiring efforts succeeded in inducing the Imperial Legislature to acknowledge the fairness of placing the duty paid by Ceylon Coffee on the same footing as that of the West Indian colonies. With the removal of this embargo, which subjected Ceylon produce to a high duty in the English market and which operated

harshly against Ceylon interests, an impetus was given at once to coffee cultivation. Enterprising men began to perceive that the formations of coffee plantations with careful cultivation, would be likely to prove a remunerative speculation. Capital was not slow to respond adequately, and ancient forests were rapidly converted into smiling plantations. After passing through varying vicissitudes of fortune, inseparable from a nascent enterprise, Ceylon very soon became the centre of flourishing coffee Industry. When, in the height of its prosperity, a leaf-disease broke out in an epidemic form and its ravages could neither be controlled nor checked by all the preventive and remedial measures, which the best efforts of man could then devise. To the infinite regret and ruin of Ceylon capitalists, this highly lucrative industry had to be abandoned as a forlorn hope.

Renewed interest is being taken by the advent in the field of Robusta species which show a remarkable resistance to the disease. This may replace successfully the Arabian coffee, which this country grew in the old days. Of its prospects in Ceylon, it is proposed to discuss atlength on a later occasion.

*Varieties.*—Coffee belongs to the natural order *Rubraciæ* and has been placed in a special genus named *coffea*. There are some 80 varieties, of which only 3 are cultivated to any large extent, namely Arabian Coffee (*C. Arabica*), Liberian Coffee (*C. Liberica*) and of late years, to smaller extent, Robusta coffee (*C. Robusta*).

*Coffee-growing Countries.*—It may not be out of place to mention here the principal coffee-growing countries in the world. They are in order of production : Brazil, Venezuela, Colombia, Haitii, Guatemala, Salvador, Dutch East Indies, Porto Rica, India, Costa Rica, Nicarugua. Of these Brazil alone produces twice as much as all other countries and that too the finest coffee

*Coffee-drinking Countries.*—United Kingdom and Ireland consumes ¾ lb. per head of the population per annum. Holland as much as 17 lb. per head. United States of America 12 lb., France 6 lb. and Germany 8 lb. per head.

*Robusta.*—There are many types of Robusta family, which DR. CRAMER considers to be identical with *C. Laurentii*. The best known among them are :—*C. Robusta*, *C. Quillou*, *C. Canephora* and *C. Uganda*.

*Coffea Robusta* is partial to moist situations and its aversion to strong wind is characteristic.

*C. Quillou* is suitable for dry estates, with a pronounced clay formation Its root system is more developed than that of *C. Robusta* and goes deeper in the ground. This is probably the main reason why Quillou can stand drought better. The type of Quillou is very regular, with a spreading of branches and is more productive.

*C. Uganda* does not require much fertility and is recommended for inferior soils, while *C. Canephora* prefers higher altitudes and a more uniform climate.

*Natural Habital Distribution.*—Robusta was first discovered in Belgian Congo and is a native of that place. From its natural abode Belgians carried it to their own country, where after propagating, plants were offered for sale for the first time in 1900. These were in demand everywhere and some found their way to Java, where investigations, already instituted by

Government, were in progress with a view to discover a blight-resistant type. Robusta was tried there, and on trial they were found to thrive exceedingly well with good results so much so that this coffee soon became a very favourite crop and to-day the Javanese Coffee plantations consist almost entirely of this species.

*General description.*—The Robusta seldom grows to a greater height, when cultivated, than 6-10 feet. It is usual however to restrict the height to 5-6 feet by "topping." The plant is of a robust habit and its oblong pointed smooth shining opposite leaves, though variable in size, are larger than those of *C. Liberica ;* but thinner and of a lighter green colour. The branches have a tendency to bend downwards, so that the bush becomes somewhat umbrella shaped. Its sesile flowers are pure white, with a pleasing scent. The plant flowers throughout the year, the flowers being intermediate in size between those of *C. Liberica* and *C. Arabica.* Fruits are succulent "cherries" and scarlet red when ripe. The most striking feature of this species is the large number of berries, borne in numerous thick clusters each of which contains on an average, 40-60 berries, though larger numbers are frequently met with. The berries are much smaller than in Liberian coffee, but since the pulp is thinner beans are not markedly different in point of size than those of *C. Arabica.* Beans, after preparation, are of light bluish green colour, smaller to that of Arabian product, but are of a somewhat different shape, being larger and more convex on the curved side.

Its chief characteristics are :—

a. Remarkable resistance to coffee blight
b. Accommodation to varying qualities of soil
c. Partial capacity to resist drought
d. Wide climatological range it can stand
e. Early maturity
f. Prolific productivity.

Against these highly desirable qualities must be set down its serious defect :

g. Lack of superior flavour and good aroma.

*Soil.*—The plant accommodates itself to varying qualities of soil, and is found to thrive equally well both on light and heavy soils if sufficiently deep, provided the necessary fertility is secured and in case of the latter, drainage is attended to. It is growing luxuriantly in the rich and fertile soils of the Government Experiment Station at Peradeniya (1600 ft.) yielding heavily and its growth and outturn have not been unsatisfactory in the light sandy soils of the Government Stock Garden at Colombo (near sea level). The roots of Coffee robusta are strongly developed and it is noticed in the nurseries that excepting the long tap root, they largely occupy the top soil. It is on this account that the soil conditions should be as favourable as possible for the development of its roots. Deep soil is an essential. Stiff and water-logging soils are as much to be avoided as poor

and sandy soils, for the former are not only hard to till, but also hard on plants, often being too wet in a wet time and too dry in a dry time. Good drainage is essential to vigorous growth and health of the tree and in this respect, undulating land is to be preferred to flat land, in that it naturally drains better. Coffee thrives well on hill sides, provided there are plenty of rocks and boulders round about, to prevent wash during heavy rains and sufficient depth of soil exists for the spreading of roots and their development, Chena land covered with small jungle, after the original forest has been cut down and utilised for growing paddy, is unfit for continued production of this crop. This soil, by the large number of weeds it produces and its exposure to the sun, is not conducive to growth of coffee. Any deep and retentive soil, rich in organic matter, will do, but an ideal soil would be loam which combining as it does the lightness and earliness of the sand with the strength and retentiveness of the clays works up easily, does not crust or crack and is well supplied with plant food. Above all, by its physical composition of 40-60% of clay and 15-20% of sand, free movement and circulation of water is rendered possible without being leachy. This type of soil requires no special treatment, except such attention to good tillage, drainage, and the addition of humus, as is the necessary part of best farm practice everywhere.

*Climate.*—Climate is a determining factor in the successful growing of a crop and sufficient consideration should be given to this aspect of the question. Meteorological requirements of several crops are entirely different from that of each other and unless this fact is clearly borne in mind and suitable climate chosen it is not possible to grow a crop and get the best out of it. Experiments in Java, show that Robusta will flourish from sea level to an altitude of 3,000 feet. In a higher elevation, as a result of more moist and frequent rain, the plant is found to tend to more vegetative growth, with a small yield, but, however, resulting in better flavoured berry. On the other hand, in the same high elevation, if the district is dry, a very fine crop may result. Elevation best suited is between 1,000 and 1,500 feet. Near the coast line it is found to thrive well at a distance of 1-20 miles. This grows best in a humid climate, i.e., where the rainfall averages between 80 and 150 inches and the temperature ranges between 55 and 100°F. Hot and dry places are not unsuitable and coffee could be successfully grown, as in the Government Experiment Station at Anuradhapura, if necessary shade is provided. Where rainfall averages below 70° and dry season is comparatively of long duration, the crop stands little or no chance. Strong and continuous winds stunt the growth of the plant and injure it severely. It is absolutely essential that wind belts should be provided in such places to ensure protection. The prevailing winds can be ascertained by the slant of the trees in the neighbourhood. Banana trees may be profitably used as hedge plants. It is likely that the plant may be so shaken by the wind in all directions, as to cause a crevice in the soil, round the tree, at the bottom, where by direct exposure to sun and stagnation of water, it may be fatally injured.

(*To be continued*)

# TOBACCO.

## TELDENIYA TOBACCO EXPERIMENTS.

G. HARBORD,

*Divisional Agricultural Officer, Central.*

These trials were started with the object of finding out whether any tobaccos are likely to give better results than the Dumbara variety for the production of cigar leaf.

We have also endeavoured to improve upon the quality of Dumbara tobacco by seed selection and improved methods in the field and of curing and fermenting.

Investigations, which have been confined to cigar types, have been carried on during the 1919, 1920, and 1921 seasons.

### CULTIVATION REPORTS.

| | | |
|---|---|---|
| *Programme of Work.*—Field Preparation | ... | January to March |
| Sowing of Seed Beds | | February |
| Planting | ... | April |
| Harvesting | ... | July, August, September |
| Fermenting | ... | October, November, December |

### 1919 CROP.

*Area.*—10 acres.

*Conditions.*—This land had not been cropped with tobacco for the preceding 3 years.

*Field Preparation.*—The strong growth of cheddy was cut and burned off. The land was then dug over twice with the mamoty and levelled.

*Seed Beds.*—Owing to bad germination of many of the varieties, there was a shortage of plants of American types, and the main portion of the area had to be filled with Dumbara plants bought locally.

*Spacing.*—2½ feet × 3 feet for large varieties (Connecticut B.L. Pennsylvania, Maryland Mamoth, Natal Selection). 2½ feet × 2 feet for small varieties (Halladay's Hybrid, Ohio Hybrid, White Honduras, Dumbara).

*Manuring.*—An artificial mixture containing Nitrogen and Potash was applied at the rate of 1 oz. per plant in some partions of the area after the plants had become established.

*Inter-cultivation.*—Individual plants were earthed up twice. No forking was done.

*Topping.*—Low topping and heavy suckering.

*Harvesting.*—Whole plant method after the removal of sand leaf.

*Curing.*—Barn curing method.

*Fermenting.*—The leaves were tied into bundles of 50 and bulked in large wooden boxes 6 feet × 4 feet × 4½ feet under pressure. The temperature was regulated by thermometers. The maximum temperature obtained was 125°F. The boxes were provided with lids. Bulk rebuilt in early stages after intervals of 7 to 10 days.

*Grading* according to class, colour, size, etc.

*Pests and Diseases.*—During the growing period, aphids were present in large numbers. Spraying with soft soap proved effective to some extent. In the Curing Shed, mildew was troublesome. The fermented tobacco became badly attacked by borer—*Lacioderma testacea*—and was satisfactorily treated with Carbon Bisulphide.

*Rainfall* was ample and well distributed.

| Date | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | ·34 | | | | ·24 | ·11 | ·47 | | | | ·14 |
| 2 | | | | | ·45 | ·03 | | | | | ·26 | |
| 3 | ·40 | | | | ·16 | ·17 | | | | | ·44 | |
| 4 | | | | ·31 | | ·20 | | ·10 | | ·52 | ·03 | ·92 |
| 5 | | | | | | ·09 | | | | ·04 | | ·83 |
| 6 | ·66 | | | | ·05 | | | | | ·33 | | ·05 |
| 7 | | | | | ·25 | | | | ·08 | ·03 | ·41 | |
| 8 | | | | | | | | ·06 | ·76 | | ·20 | ·82 |
| 9 | | | | | ·58 | | | ·20 | ·06 | | | ·08 |
| 10 | | | | | | | | ·10 | ·05 | | | |
| 11 | | | | | | | | | ·51 | | | |
| 12 | | | | | | | | | ·10 | ·19 | ·50 | |
| 13 | | | | ·15 | ·70 | | | | | ·38 | ·22 | |
| 14 | | | | ·14 | | | ·17 | | | ·64 | ·15 | |
| 15 | | | | ·38 | | | | | | ·05 | | |
| 16 | | | ·75 | ·20 | ·28 | | ·18 | | | ·90 | | ·09 |
| 17 | | | | ·16 | ·13 | | ·30 | | ·36 | ·24 | | |
| 18 | ·13 | | ·68 | ·18 | | ·34 | ·04 | ·01 | | | | |
| 19 | ·60 | | 1·61 | ·16 | | ·01 | | ·01 | | | ·44 | ·42 |
| 20 | ·04 | | 1·80 | 1·12 | ·24 | ·10 | | ·03 | ·22 | | ·55 | ·19 |
| 21 | | | | ·41 | | | ·07 | ·07 | ·03 | | 1·36 | 1·50 |
| 22 | | | | ·07 | | | | ·27 | ·27 | ·21 | ·12 | 1·13 |
| 23 | | | | | | | 1·32 | | 2·38 | 1·23 | | ·12 |
| 24 | | | | ·12 | | ·09 | ·15 | ·18 | ·45 | 1·58 | ·40 | ·28 |
| 25 | | | | ·35 | 1·11 | ·23 | ·06 | | ·37 | 1·33 | ·61 | ·58 |
| 26 | | | | ·40 | | ·47 | | | ·07 | 1·01 | ·23 | ·09 |
| 27 | ·37 | | ·02 | ·52 | ·20 | ·35 | ·12 | | ·41 | ·06 | 3·62 | ·85 |
| 28 | | | | | ·22 | ·41 | | | ·10 | ·17 | | ·02 |
| 29 | | | | | ·48 | | ·03 | | ·06 | ·16 | 1·04 | ·03 |
| 30 | | | | | | ·09 | 1·04 | | ·22 | ·10 | 3·32 | ·19 |
| 31 | ·71 | | | | ·25 | | 1·29 | | | ·34 | | |
| | 2·91 | ·34 | 4·86 | 4·67 | 5·10 | 2·82 | 4·88 | 1·50 | 6·50 | 9·51 | 13·90 | 8·33 |

Total rainfall - 55·88 inches.

*Varieties, Yields and Observations.*

| Varieties | Maryland Mammoth | Connecticut B.L. | Pennsylvania B.L. | Halladay's Hybrid | White Honduras | Natal Selection | Wilson Hybrid | Ohio Hybrid | Dumbara |
|---|---|---|---|---|---|---|---|---|---|
| | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| Wrapper - | 97 | 93 | 33 | 101 | 40 | 42 | 18 | 24 | 1,410½ |
| Binder - | 47 | 22 | 16 | 81 | 60 | 12 | 17 | 12 | 1,596 |
| Filler - | 26 | 18 | 2 | 45 | 19 | 12 | 37 | 7 | 514 |
| | 170 | 133 | 51 | 227 | 119 | 66 | 72 | 43 | 3,521 |

Total - American varieties 1,099 lb.
Dumbara 3,521 ,,

4,620 ,, from 10 acres.

i.e., 462 lb. per acre.

It is impossible fo give figures relating to yields per acre as plots and rows of the different types were necessarily scattered.

The tobacco was transferred to the Experiment Station, Peradeniya, for the fermentation process.

The method of fermenting in boxes proved unsuitable for the humid climate at Peradeniya.

Best results were obtained from Maryland Mamoth, Pennsylvania Broadleaf, Connecticut Broadleaf, Halladay's Hybrid and Dumbara.

The season was considered to be a favourable one for tobacco growing.

**1920 CROP.**

*Area.*—6 acres (same land as for previous trial).

*Field Preparation.*—The land was dug over twice with the mamoty and levelled.

*Seed Beds.*—Were rather unsatisfactory due to unskilful preparation, damage by rain and by swarms of caterpillars. Germination was very poor in some varieties.

*Spacing.*—2 feet by 2½ feet.

*Manuring.*—A green manuring crop of green gram was grown in the interval between the harvesting of the previous tobacco crop and the preparation of the land for this crop. The crop of gram which was a light one owing to attacks of hares and snails was dug in at the time of flowering. There was no application of artificial manure made to the tobacco crop.

*Inter-cultivation.*—Plants were earthed up along the rows twice.

*Topping.*—High topping and severe suckering.

*Harvesting.*—Single leaf method.

*Curing.*—Barn curing method.

*Fermenting.*—The leaves were tied into bundles of fifty and built into a bulk or staple placed in the open on upstair floor of large store at Experiment Station, Peradeniya. Temperature regulated by thermometer. Maximum temperature obtained 119°F. Staple rebuilt in early stages after intervals of 7 to 10 days.

*Grading.*—according to class, colour, size, etc.

*Pests and Diseases.*—The stem borer *Gnorimoschema helispa* gave a considerable amount of trouble in the young plants. The percentage of "wilt" plants caused by a root fungus, was high. Leaf-eating caterpillars in the field and mildew in the curing shed, were dealt with without much difficulty.

*Rainfall* was not well distributed. Excessive rain in April damaged the nursery plants and those newly planted—followed by drought and hot sun in May which baked the land.

*Rainfall* :—

| Date | Jany. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ·12 | | ·15 | | 2·12 | | ·12 | | | ·24 | ·12 | ·14 |
| 2 | ·93 | | ·07 | | ·37 | ·83 | ·14 | | | 2·06 | ·04 | |
| 3 | 1·11 | | ·33 | | | 1·03 | ·10 | | | ·06 | ·73 | |
| 4 | ·40 | | ·13 | | | ·06 | ·16 | | | ·16 | ·40 | |
| 5 | ·03 | | ·15 | 1·16 | | | ·28 | | | ·17 | ·26 | |
| 6 | | | ·80 | | | | ·27 | | | ·30 | ·36 | |
| 7 | ·08 | | | | | | | | | | 4·23 | |
| 8 | | | | 1·20 | | | ·22 | | | ·17 | ·80 | |
| 9 | | | | ·24 | | | | | | ·27 | ·30 | |
| 10 | | | | ·08 | | | | | | | ·20 | |
| 11 | | | | ·02 | | | | ·47 | | | ·93 | ·67 |
| 12 | | | ·12 | ·33 | | 1·17 | | | | | ·25 | 2·22 |
| 13 | | | | ·03 | | | | | | | ·16 | ·68 |
| 14 | 1·08 | | ·03 | ·10 | | ·68 | ·22 | | | | 2·90 | 1·50 |
| 15 | ·05 | | | ·27 | | ·28 | | | | | ·78 | ·03 |
| 16 | | | | ·26 | | ·10 | | | | | 1·17 | ·44 |
| 17 | | | | ·24 | | ·28 | | | | | 1·35 | ·71 |
| 18 | | ·24 | | ·07 | | ·60 | | | | ·13 | ·07 | |
| 19 | | | | 3·30 | | ·26 | | | | 1·38 | ·12 | ·18 |
| 20 | | | ·23 | 1·02 | | 1·05 | | | | ·23 | 3·20 | |
| 21 | | | | ·10 | | ·33 | | | | ·29 | 1·67 | |
| 22 | ·16 | | | ·09 | ·05 | ·12 | | ·28 | | 1·93 | ·06 | |
| 23 | | | | ·09 | | ·10 | ·34 | | | 0·4 | 1·80 | |
| 24 | | | | ·84 | | ·10 | ·12 | | | | 1·74 | |
| 25 | | | | ·30 | | ·15 | ·26 | | | | ·05 | |
| 26 | | ·36 | | ·12 | ·25 | ·10 | ·08 | | | 1·46 | ·70 | |
| 27 | | ·13 | | ·31 | | ·27 | | ·3 | ·34 | ·05 | 1·57 | |
| 28 | | ·03 | | ·09 | | | | | ·32 | | ·17 | |
| 29 | | ·10 | ·80 | ·32 | | ·90 | 1·07 | | ·29 | | ·07 | |
| 30 | | | ·02 | ·07 | | ·17 | | | ·21 | | | 1·04 |
| 31 | | | | | | | | | | | | ·10 |
| | 3·96 | ·86 | 2·83 | 10·67 | 2·79 | 8·68 | 3·38 | ·78 | 1·16 | 8·77 | 26·24 | 7·71 |

Total Rainfall - 77·76 inches

*Varieties, Yields and Observations*

| Varieties | Pennsylvania B.L. | White Honduras | Connecticut B.L. | Jamaican | Wilson Hybrid | Ohio Hybrid | Natal Selection | Halladay's Hybrid | Mexican | Zimmer Spanish | Dumbara | Adcock | Brazilian | Maryland Mamoth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb | lb. | lb. | lb. |
| Wrapper | 130½ | 128 | 42 | 15 | 88 | 80 | 42 | 145 | 42 | 36 | 206 | 2 | ½ | 5 |
| Binder | 20 | 15 | 24 | 3 | 9 | 11 | 4 | 10 | 5 | 4 | 25 | ¾ | — | ¼ |
| Filler | 46 | 17½ | 28 | 7 | 22 | 47 | 22 | 30 | 20 | 23 | 45 | — | ½ | ... |
| | 196½ | 160½ | 94 | 25 | 119 | 138 | 68 | 185 | 67 | 63 | 275 | 2¾ | 1 | ¼ |

Total — American varieties — 1,125 lb.
Dumbara 276 ,,

1,401 lb. from 6 acres
i.e., 233 lb. per acre.

Half acre plots were grown of each variety with the exception of Maryland Mamoth, Brazilian, Adcock—of which a few plants only were grown. Also Jamaican and Mexican, grown on ¼ acre plots.

In addition to Pennsylvania Broadleaf, Connecticut Broadleaf, Halladay's Hybrid and Dumbara, both Zimmer Spanish and Mexican gave promising results.

The fermented tobacco showed a distinct improvement on the 1919 leaf and there was no damage done by borer. The tobacco was treated with Carbon bisulphide as a precautionary measure.

The season was considered to be none too favourable for tobacco. The rainfall was not well distributed.

**1921 CROP.**

*Area.*—3 acres.

*Field preparation.*—This land had not been cropped with tobacco during the 3 preceding years. It had remained fallow and been regularly grazed with cattle. The land was dug twice with the mamoty and levelled.

*Seed beds* were very satisfactory.

*Spacing*, 2 feet by 3 feet.

*Manuring*, ½ oz. of Nitrate of Potash applied to each plant when well established.

*Inter-cultivation.*—Plants were earthed up along the rows three times, Ridges and furrows were thus formed. The furrows were kept lightly forked.

*Harvesting.*—Single leaf method.

*Curing.*—Barn Curing method.

*Fermenting.*—Bundles of 50 leaves built into a staple placed on a beaten earth floor of mud walled store room at Teldeniya. Temperature regulated by thermometer. Maximum temperature 114° F.

Staple rebuilt in early stages at intervals of 7 to 10 days.

*Pests and Diseases.*—The stem borer was very bad, and necessitated constant re-supplying. The presence of leaf-eating caterpillars, grass hoppers and aphids required careful attention.

There was little trouble with mildew in the Curing Shed.

*Rainfall*—An exceptionally severe drought was experienced immediately after planting and continued for 2½ months with practically no break. The crop was with difficulty kept alive by means of frequent surface cultivation.

*Rainfall:—*

| Date | Jany. | Feby. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | ·30 | ·20 | | | ·43 | | ·28 | ·26 | ·11 |
| 2 | | | | | | | | ·32 | ·36 | 2·56 | ·53 | |
| 3 | | | | | | | | ·88 | ·18 | 2·84 | | |
| 4 | | | | ·80 | ·05 | ·05 | ·10 | ·10 | | ·03 | ·21 | |
| 5 | | | | | ·10 | | | ·11 | | ·13 | ·15 | ·10 |
| 6 | | | | | | | ·09 | ·10 | | | ·08 | ·70 |
| 7 | | | | ·05 | | ·45 | | ·25 | ·25 | | | |
| 8 | | | | | | | | | ·10 | | | ·71 |
| 9 | | | | ·25 | | | | | ·11 | ·38 | | ·08 |
| 10 | | | | ·40 | | | | | ·14 | | | ·40 |
| 11 | | | | 1·60 | | | | ·14 | | ·13 | | |
| 12 | | | | ·32 | | | | | | | | |
| 13 | | | | ·20 | | | | | | | ·71 | |
| 14 | | | | ·40 | | | | | | | ·07 | |
| 15 | | | | ·67 | | | | | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | ·10 | | ·88 | | |
| 18 | | | | | | | | ·20 | | 1·24 | ·90 | ·80 |
| 19 | | | | ·45 | | ·10 | ·05 | ·13 | | ·80 | ·30 | |
| 20 | | | | | | | ·10 | | | ·72 | | |
| 21 | | | | | | | ·07 | ·06 | | ·06 | | |
| 22 | | | | | | | ·06 | | | ·56 | | |
| 23 | | | ·07 | | | | ·13 | | | | | |
| 24 | | | ·25 | ·55 | | | ·12 | ·10 | | ·73 | ·20 | |
| 25 | | | 1·45 | | ·15 | | ·10 | 1·03 | | ·29 | | |
| 26 | | | | ·60 | | | ·14 | ·13 | | ·10 | ·90 | 1·30 |
| 27 | | | | ·20 | | | ·11 | 1·02 | ·06 | ·20 | ·30 | 6·18 |
| 28 | | | | ·22 | | | ·31 | 1·12 | ·14 | ·09 | | |
| 29 | | | | ·35 | | | ·55 | ·03 | ·41 | ·10 | | ·40 |
| 30 | | | ·40 | | | | ·40 | | ·42 | ·06 | | |
| 31 | | | 2·15 | | | | ·48 | | | ·56 | | |
| | | | 4·32 | 7·36 | ·50 | ·60 | 2·81 | 6·25 | 2·17 | 12·74 | 4·61 | 10·78 |

Total Rainfall - 52·24 inches. 10 months.

*Varieties, Yields and Observations.*

| Varieties | Maryland Mamoth | Connecticut B.L. | Halladay's Hybrid | White Honduras | Ohio Hybrid | Natal Selection | Mexican | Dumbara | Dumbara Special |
|---|---|---|---|---|---|---|---|---|---|
| | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| Wght. in lb. | 90 | 147 | 88 | 115 | 177 | 41 | 3 | 622 | 80 |

Total - American varieties 661
Dumbara 306

967 lb. from 3 acres, i.e., 322 lb. per acre.

No useful comparison can be made of the returns per acre of individual varieties, owing to the high percentage of vacancies caused by the exceptional drought.

At the same time the value of inter-cultivation was clearly demonstrated at the Tobacco Trial Ground.

The tobacco is still undergoing fermentation, but there is no doubt that the quality of the tobacco is an improvement on that of the 1920 Crop.

The stand out varieties as regards yield, quality of leaf and hardiness were Maryland Mamoth, Halladay's hybrid and Dumbara.

**SOIL ANALYSIS.**

The Government Agricultural Chemist reports as follows :—

"Sample A. is a dark brown clayey loam with a tendency to harden in dry weather. It has rather more humus than B. Sample B. is a rather lighter coloured free sandy loam being rather less retentive of moisture than A. Chemically both soils have a fair amount of reserve nitrogen and are unusually rich in Lime and Magnesia for Ceylon soils. The phosphoric acid is also considerably above the average while the potash is normal, though not equal to the Jaffna tobacco soils. The percentage of soda is rather high especially in A. The citric Soluble Potash and Phosphoric acid is rather above normal in both soils. The Chlorine is the same as in the Jaffna Tobacco Experiment Station soils."

Samples taken from Tobacco Trial Ground, Teldeniya—1921 Crop.

**MECHANICAL COMPOSITION.**

| | *A.* | *B.* |
|---|---|---|
| Hygroscopic Moisture and Salts dissolved ... ... | 3·80% | 3·60% |
| Humus ... ... | 3·00 ,, (1·5) | 2·60 ,, (1·42) |
| Clay ... ... ... | 10·60 ,, | 7·90 ,, |
| Fine Silt ... ... | 9·60 ,, | 8·40 ,, |
| Silt . ... ... | 4·70 ,, | 4·80 ,, |
| Coarse Sand ... ... | 32·00 ,, | 32·80 ,, |
| Fine Gravel ... ... | 11·10 ,, | 10·70 ,, |
| | 100·00 | 100·00 |
| Coarse Gravel ... | 3·10% | 0·70% |
| Water Absorption ... | 40·00 ,, | 37·00 ,, |

**CHEMICAL COMPOSITION.**

| | | |
|---|---|---|
| Moisture ... ... | 3·300% | 2·600% |
| Organic Matter & Combined Water ... | 8·300 ,, | 6·800 ,, |
| Oxide of Iron and Manganese ... | 9·600 ,, | 9·760 ,, |
| Oxide of Alumina ... ... | 14·284 ,, | 11·271 ,, |
| Lime ... ... | 0·880 ,, | 1·700 ,, |
| Chlorine ... ... | 0·619 ,, | 0·014 ,, |
| Balphaiac-Anyhydride ... | 0·041 ,, | 0·019 ,, |
| Potash . ... | 0·147 ,, | 0·154 ,, |
| Soda ... ... | 1·425 ,, | 0·996 ,, |
| Phosphoric Acid ... ... | 0·205 ,, | 0·154 ,, |
| Soluble Silica ... ... | 1·180 ,, | 1·080 ,, |
| Silicates ... ... | 60·000 ,, | 64·800 ,, |
| | 100·000 | 100·000 |
| Citric Sol : Phos. Acid .. | 0·008% | 0·007% |
| Citric Sol : Potash ... ... | 0·008 ,, | 0·009 ,, |
| Containing Nitrogen ... | 0·062 ,, | 0·134 ,, |
| Equal to Ammonia ... ... | 0·097 ,, | 0·163 ,, |
| Lower oxide of iron ... | Good | Good |
| Acidity ... ... | Neutral | Faintly acid |
| Humus ... ... | Fair | Fair |

## SEED SELECTION.

Each season selected plants of the varieties grown were bagged, and a limited stock of pure seed of the following varieties is available :—

| | |
|---|---|
| Maryland Mamoth | 1921 Selected seed. |
| Halladay's Hybrid | |
| Mexican | |
| Connecticut Broadleaf | |
| Natal Selection | |
| White Honduras (Red flower) | |
| Dumbara | |
| Dumbara Special | |
| Jaffna | |
| Maryland Mamoth | 1920 Selected seed |
| Halladay's Hybrid | |
| Connecticut Broadleaf | |
| Zimmer Spanish | |
| Jamaican | |
| Brazilian | |
| Natal Selection | |
| White Honduras | |
| Adcock | |
| Ohio Hybrid | |
| Wilson Hybrid | |

## MANUFACTURE OF CIGARS.

Samples of cigars, both pure and blended, of the 1919 and 1920 Crop tobacco have been prepared in boxes of 100 each, as follows :—

| | Boxes |
|---|---|
| Connecticut Broadleaf, 1919 ... ... | 13 |
| Halladay's Hybrid, 1919 ... ... | 1 |
| Mixed 1919 ... ... ... | 18 |
| Dumbara 1919 with Halladay's hybrid wrappers, 1920 ... ... ... | 7 |
| Dumbara 1919 with Pennsylvania B. L. wrappers, 1920 ... ... ... | 10 |
| Mexican, 1920 ... ... ... | 2 |
| Mexican with Pennsylvania B. L. wrappers, 1920 ... | 1 |
| Mexican with Halladay's hybrid wrappers, 1920 .. | 1 |
| Pennsylvania Broadleaf, 1920 ... ... | 5 |
| Connecticut Broadleaf, 1920 ... ... | 1 |
| Maryland Mamoth, 1920 ... ... | 1 |
| Zimmer Spanish ... ... ... | 3 |
| Jamaican, 1920 ... ... ... | 2 |
| Wilson Hybrid, 1920 ... ... | 1 |
| Ohio Hybrid, 1920 ... ... | 1 |
| Natal Selection, 1920 ... ... | 1 |
| White Honduras ... ... ... | 1 |
| Dumbara, 1920 ... ... ... | 2 |
| Halladay's Hybrid, 1920 ... ... | 1 |
| | 72 |

The quantity of 1920 Crop tobacco available for the manufacture of Cigars is as follows :—

| | |
|---|---|
| Wrappers ... | 639 lb. |
| Binders and Fillers ... | 428 lb. |
| | 1067 lb. |

### REPORTS.

Practically the whole of the 1919 Crop tobacco was forwarded during August and November, 1920, to the Imperial Institute, the Imperial Tobacco Company and the Crown Agents; and from the reports received it would appear that there is little demand for such tobacco in England.

Samples of 1919, 1920 and 1921 Crop tobacco have recently been sen to India to MESSRS. SPENCER & Co., Dindigul, and to MESSRS. MCDOWELL Madras, and reports from them are expected shortly.

### SUMMARY.

We have endeavoured by improved methods to produce superior Dumbara leaf, and perhaps with some success, but until and unless there is a market for such tobacco, the local cultivator will naturally be slow to alter his methods.

Practically all the leaf which Dumbara and Matale can produce is quickly bought up by Jaffna traders for use in the manufacture of Jaffna cheroots.

An American Tobacco Expert MR. STAPLES visited Teldeniya in February, 1921, and was favourably impressed with the Dumbara leaf. MR. WILSON, Tobacco adviser, also thought highly of the local tobacco. The quality of the leaf is good but the shape inferior.

I am inclined to believe that a local industry could be developed in the manufacture of mild agreeable flavoured cigars suitable for the Eastern trade.

## A TOBACCO CURING QUERY.

The successful processing of the tobacco leaf after harvesting calls for some care and accuracy. All the leaves on a plant do not ripen at once, and as individual leaves come to maturity it is advisable to pick them and subject them to the "priming" process, which consists of stringing them up in the shade of a well-ventilated barn, and prefaces drying and curing.

In a recent letter to the Department of Agriculture a grower described how he had experienced some trouble with this "priming" process. After four days the leaves had become so brittle as to break on being handled (far too brittle for subsequent handling), although they were still almost green.

For priming (explains the Tobacco Expert of the Department) the leaves should be placed close together; not until they assume a yellow colour should they be separated and dried out. If the leaves are picked green and hung up in a well-ventilated building they will probably dry out green. The stage at which to pick the leaves for the best results from air-curing is when they are greenish-yellow—more yellow than green.

If the leaves are picked when ripe and are hung shaded from the sun and close together, four days is usually sufficient for the priming process in the warmer months; but they will require to hang for some eight or ten weeks in the barn before being ready for bulking. Care should be taken that the stem or mid-rib has completely dried out. Opportunity to bulk should then be taken when damp weather has brought the leaf into suitable condition.—AGRIC. GAZ. OF N.S.W., VOL, XXXII, PART 12.

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# FRUITS.

## THE MANGO.

NOTES FROM RECENT LITERATURE.

**H. L. VAN BUUREN, Dipl. Agr. (Poona).**

*Assistant to Economic Botanist, Department of Agriculture, Ceylon.*

Of more than passing interest to mango-growers is "The Book of the Mango" by BURNS and PRAYAG, being Bulletin No. 103 of 1920 of the Department of Agriculture, Bombay. This embodies the results of observations and experiments made since 1908 in the Ganeshkhind Botanical Gardens, near Poona, and in various parts of the Bombay Presidency. With extracts and précis from all available literature, the writers bring out the practical problems they are engaged in investigating, suggesting what there is still to be known by furnishing us with all that is known at the present day on them.

### PROPAGATION BY SEED.

Propagation by seed appears to be worth re-considering because some types are known to give seed that give rise to more than one seedling each, i.e., they are polyembryonic. Polyembryonic mangos form a class in themselves. They are unknown in India but are common in the New World.

In Ceylon, this characteristic has on more than one occasion been brought to the notice of the writer but it was difficult in each case to be sure of the origin of the seed; there is a suspicion, nevertheless, that at least in one instance the seed was of a Ceylon type. The interest in this phenomenon is that American investigators have found polyembryonic mangos coming true to type when propagated by seed. Otherwise, propagation by seed, although the easiest, is not the best method : this because one cannot be sure that the seedling tree will bear the same quality of fruits as its parent.

## GRAFTING.

The best method of propagating the mango is by grafting. Different methods of grafting are described but investigation and experience make the writers to recommend " inarching."

Before grafting it is necessary first to grow your stock plants. For these, seeds must be obtained from a good hardy tree found locally; a semi-wild tree would perhaps be better than any other. The seeds must be germinated fresh : After a month, it is their experience that the germination capacity rapidly decreases. The writers recommend growing seedlings in pots placed in trenches deep enough for the brims of the pots standing in them to come on a level with the surface. Dry leaves should be packed round the pots in the trenches. To get strong seedlings a quick-acting fertiliser is recommended. They have found that one ounce of sodium nitrate per plant applied every six to eight weeks gave good results. Grafting should be done when the stocks are $1\frac{1}{2}$ to $2\frac{1}{2}$ years old. If done on younger stocks the resulting plants are less strong and durable and also do not fruit early. If the seedlings are sturdy and well-nourished then " inarching " on one year old stocks is recommended. This is described as follows:— " The stock in its pot is placed so that a branch of the tree from which the scion is to be taken is in contact with the stock. If necessary, the branches bearing the scions should be bent down and fixed conveniently. Where branches cannot be bent so as to meet pot plants on the ground, these pot plants must be elevated on a scaffolding to meet the scion branches. In the Konkan, the pots are tied to the branches of the trees close to the scion. By any of the above methods a large number of stocks can be grafted on from one tree. The branch of the scion is brought close to the stock, and at the point of contact a thin slice of bark and wood is removed from each. The slice may be two or three inches long, $\frac{1}{4}$ inch broad, and about $\frac{1}{6}$ inch deep. The cut surfaces should fit each other so that union may be perfect. The cut surfaces should immediately be tied together and covered with grafting clay or wax. It takes nearly two months for perfect union to take place. A month and half after grafting, a cut is made in the scion between the point of junction and the parent tree. This cut is deepened after a week and the scion completely severed after another fortnight. The original top of the stock is then removed. The cuts are later on trimmed and the cut ends tarred."

In Poona it is the usual thing to use the inner part of the sheaf of the plantain leaf, cut into strips, as a substitute for waxed tape. This is applied first, thoroughly moistened, and string tied above it. Then the whole is covered with grafting clay made by mixing equal parts of fresh cowdung and clayey soil. Till union is complete the pots need careful watering.

## ESTABLISHING THE PLANTATION.

Planting out at distances of thirty feet is advocated. To prevent water-logging, it is better to plant about the end of the rains, especially in districts with a rainfall above 60 inches. Also, "It is always preferable to transplant when the trees are not in flush." In filling up the pits, the writers recommend mixing 1 cwt. of well-rotted farmyard manure plus 5 lb. of bone meal and 10 lb. wood-ashes with the earth to be placed in the pit.

## AFTER CARE.

Till its fourth year it is necessary to irrigate the grafted plants. This, at the commencement, should be done once in three days when there is no rain. After the fourth year watering is not necessary unless the tree actually shows signs of withering. Manuring will be necessary only if inter-crops of vegetables or other food-crops are taken from the soil. Pruning will be necessary to get a good shape. From its fourth year onwards a grafted tree begins to bear. No rationale of pruning for fruits has yet been devised : it is advisable, however, to prune bearing trees after the rains, removing only dead or diseased branches and such as are obviously superfluous.

## HARVESTING AND RIPENING.

Harvesting should be done before the mangos are quite ripe. "The exact time when picking should be done is a matter of personal experience. As a rule, when three or four semi-ripe windfalls are discovered and the fruits are full-sized, picking from that tree may commence."

There are some interesting notes on ripening. "After picking, the fruits must be kept cool and away from the direct sun. They are transferred to a store-house for ripening. The fruits are first spread in one layer on a bed of mango leaves at least four inches thick, and left there for two days exposed. They are then transferred to straw for ripening. In some store-houses half the space is reserved for spreading and half for ripening proper. The store-house should be well ventilated and not completely dark. Country varieties are kept in straw of *Iseilema Wightii* (Sheda). Three to five layers of such fruits are built up separated by two inches of grass. *Ischaemum sulcatum* (Pawna) is avoided as it is found to have the effect of retarding ripening. For superior varieties such as Pairi and Alphonse rice straw is used. This allows of uniform ripening and good coloration. Besides, it is soft and there is no danger of marking the fruit and so spoiling its market value. Two layers at most of such varieties are built up but it is desirable to keep only one layer. Fruits thus preserved in straw ripen about the sixth day and the whole lot is taken out for immediate sale. Sorting is generally done at this time but this would be better done at an earlier stage, namely, immediately after picking, as the fruits can then be handled without damage. If it is desired to delay ripening, then the fruits are not put in straw but are kept exposed on a bed of mango leaves. By this means the ripening can be delayed by about a week."

There are further chapters on "The Transport of Trees, Scions and Seeds," "Renovation of neglected Plantations," "Flowering and Pollination," "Pests and Diseases," "Uses and Canning," and "Mango Classification." The appendix consists of a "Descriptive list of Names of Varieties" numbering some 89 with line-drawings.

## VARIETIES.

In establishing a mango plantation the question first to decide is whether you would import your plants or whether you would propagate from a good type close at hand. The former is widely practised in Ceylon (grafting being unknown) but this is a very expensive matter. Also, unless the superior foreign types are known, indiscriminate importation is likely to cause disappointment. There are hundreds of types in India that are worthless.

The leading varieties of Bombay that keep well are :—ALPHONSE, FERNANDIN, SAKHARIA, BORSHA, BATLI, and KHOONT. They come into the Bombay market from the middle of May till the end of June. After July two Madras varieties come into the Bombay market, i.e. TOTAPURI and NEELUMB. The former is known in Porto Rico as "TOTAPARI" and is there well reported as a "tree of vigorous growth, precocious and a regular and prolific bearer."

The "PAIRI" is considered to be the second most important mango of Bombay but is of poor keeping quality. It can be recommended for home consumption. BURNS speaks highly of it and so does HIGGINS (Hawaii) and KINMAN (Porto Rico). The last two place it first in flavour and quality. It is also stated to be resistant to fruit flies.

## THE "ALPHONSE" ORDER.

The "ALPHONSE" is the most widely cultivated mango in Bombay, and perhaps, in the whole of India. The "FERNANDIN" belongs to the same class and is considered "a fruit of superior sort," with a taste that is "highly delicious." The imported "FERNANDEZ" of Florida is considered to be of little value and is a good illustration of what happens unless care is exercised in importing from a reliable source.

The "MULGOBA" is a Madras type which meets with its best development in Bangalore. WESTER* summarizes American experience of this type. He writes: "The tree is very vigorous and of symmetrical growth but lacking in precocity, and has not proved to be either a constant or prolific bearer. From the observations of the writer this is to a large measure due to imperfect fertilization of the flowers. The defect might be overcome by the discovery of some variety whose pollen is more potent than its own, trees of which should then be planted among the *Mulgoba* trees. The *Mulgoba* was the first Indian mango introduced into Florida and was at first extensively planted, but because of its shy bearing qualities it has been discarded in favour of more precocious productive sorts. In appearance and quality the *Mulgoba* is exceptionally good and while commercially unprofitable it is well worthy of a place in a private collection of mangos."

The leading mango of Florida now is the "HADEN" mango which originated as a seedling of the *Mulgoba*. This resembles the *Mulgoba* very closely both in form and quality and is thought to be more productive. It is also a more highly coloured fruit.

Both the *Haden* and *Mulgoba* will be referred to the "Alphonse" Order of mangos characterised by long fruits with no beak and with a high left shoulder. Also, probably, the Bombay "BORSHA" mentioned above, the Ceylon "CHEMPADA MA" (from Jaffna) and the "SINGAPURI" of Sahranpur as described and figured by HARTLESS† The last is reported to be "cold resistant" and is worthy of note for introduction into higher elevations in Ceylon.

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* A Descriptive List of Mango Varieties in India by P. J. WESTER, THE PHILIPPINE AGRICULTURAL REVIEW, Vol. XIII, No. 4, page 265.

† From a cyclostyled copy of notes and line drawings by A. C. HARTLESS, Supt. Govt. Bot. Gardens, Sahranpur.

## CLASSIFICATION OF MANGOS.

BURNS and PRAYAG's classification is as follows :—

1. *Cohort I.*

   Round Fruited.

   Order No. 1. "ROOS"

   Order No. 2. "RAMPHALYA"—Very broad in proportion to length

   Order No. 2. "DALIMBYA"—Shoulders ridged.

2. *Cohort II.*

   Long Fruited

   Order No. 1 "BATLI."—Much elongated.

   Order No. 2 "TOTAPURI."—Elongated with downward pointing beak.

   Order No. 3 "COWASJI PATEL."—Elongated, slight beak and ridged shoulders.

   Order No. 4 "ALPHONSE."—No beak, high left shoulder.

   Order No. 5 "PAIRI."—Broad, marked beak.

*Unclassified or Indefinite Forms*:—"Those that fall in neither class on account of being on the border line between the classes and, in addition, of somewhat variable nature."

## THE "PAIRI" ORDER.

The "PAIRI," as previously mentioned, is considered by some to be the finest mango in India but it is of very poor keeping quality.

The "BOMBAY" mango of Madras, Calcutta, Ceylon or America is more often a form referable to the "Pairi" Order. The Ceylon "BETI-AMBA" is thought by some to have been actually introduced from Bombay. It has the typical "Pairi" shape and is probably the commonest variety to be found in the Ceylon markets.

The "BOMBAY MANGO (Calcutta Garden)" of Sahranpur as described and figured by HARTLESS comes under this order. It is described as a good keeper, resistant to cold and prolific. It might be worthy of introduction into the higher elevations of Ceylon.

The "Bombay" Group of mangos as described by ROLFS of Florida does not seem to have any particular relationship with one another and appear to be mixed with forms of the "Alphonse" Order.

In Hawaii there are two varieties referable to this order which are among the leading mango varieties there. The "PAHERI" is doubtlessly the same as "PAIRI" and KINMAN's opinion of it has been referred to elsewhere. The other variety is the "AMINI" also introduced from India. KILMAN's* notes on this type are : "The variety is one of the most regular and prolific tested, being excelled slightly by *Sundersha* and *Totafari*, while its fruiting season is usually longer than that of other varieties." The flesh is described as "firm, juicy, fibreless, of pleasing flavour and rather strong aroma."

## THE "COWASJI PATEL" ORDER.

The mangos of this group are generally insipid fruits or turpentiny and slightly sour in taste. The "Cowasji Patel" is a very rough and knobby fruit. The mango known under the sobriquet of the "SODA WATER" mango by the Ceylon schoolboy ("Pol Amba" *Sinh.*) belongs to this group. Mangos of this group form the basis of the celebrated mango chutneys and pickles of Bombay and perhaps India.

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* THE MANGO IN PORTO RICO, C. F. KINMAN. P. R. AGR. EXPT. STAT. BULL. No. 24, 1918.

## THE "TOTAPURI" ORDER.

The "TOTAPURI" is not quite like the Porto Rican "TOTAFARI" mentioned above although the latter is of Indian origin. KINMAN's observations on the "TOTAFARI" are thus described :—

"The tree is a vigorous grower, open and spreading in habit. It comes into bearing at two or three years after grafting, and is a regular and prolific bearer, the fruit of an individual tree being uniform in size for a given crop. The fruits are sometimes attacked by fruit flies, though seldom seriously. They keep well after picking, and are attractive and suitable for both home and market use." The flavour is described as "subacid, spicy, and very agreeable."

The "TOTAPURI" of Sahranpur is also "acid and of spicy flavour" according to HARTLESS.

The pleasantly acid taste characterises mangos of this group. Thus the Bombay "POPATIA" is "slightly acid but pleasant" (BURNS and PRAYAG). ROLFS* in classifying the Floridan mangos places "Totafari" in the "Pine-apple Group," so named, probably, from a resemblance in taste and flavour to pine-apple which is characteristic of the "PINE-APPLE" mango of Florida said to be derived from Mexican seedlings.

The Ceylon "PARROT" mango ("Gira Amba" *Sinh.*) comes under this group and is a very fair example of the shape and flavour to be expected in mangos of this order.

A noteworthy variety that is probably a close relative to "Totapuri" is the "SANDERSHAH" of Florida. This must not be confused with the "SOONDERSHAH" of Sahranpur as described by HARTLESS which appears to be a very inferior mango of little if any merit.

The Floridan "Sandershah" was introduced from Bangalore and although it is in flavour reported to be neither so rich nor pleasing as Alphonse, Pairi or Mulgoba, yet the attractive appearance, the size of the fruit, which in many cases weigh over two pounds, and its characteristics as a regular and prolific bearer, ripening late, place it amongst the best of the Indian mangos introduced to America. It is recommended as a canning or preserving mango.

HARTLESS's "KARELIA" of Sahranpur has a form very nearly similar to the American type and is recommended for trial.

## THE "BATLI" ORDER.

The Bombay mangos of this group worthy of introduction and trial, apart from "BATLI" as mentioned previously, are "DODI," "CALCUTTIO," "KELYA," and "CHATRAPATI." These are all characterised as "luscious" or sweet and pleasant in taste.

The Sahranpur varieties of "GOLA," "SUFAIDA" and "HATHIJUHL" apparently belong to this group. The two former were introduced to America. The first variety is under trial in Florida. HARTLESS characterises it as a sparse bearer, hardy and cold-resistant, ripens late, keeps well, juicy, of good flavour. In quality it may be classed as second-rate.

The "SUFAIDA" was introduced into Porto Rico and has been found to be a vigorous grower and a regular but not prolific cropper. The flavour is "sweet, refreshing, pleasant and fairly rich." This variety has a later fruiting season than any other tested in Porto Rico. A defect is that the fruits often crack before they are ripe. The "HATHIJUHL" is also of good quality and deserves mention particularly for trial at high elevations.

## THE "ROUND FRUITED" MANGOS.

In this class the Bombay varieties worthy of mention are "ROOS," "DILPASANT," "RAMPHALYA," "SAKHAR GOOTY" and "DALIMBYA." They are all classed as "delicious," "luscious," "pleasant and somewhat heavy.

* Mangos in Florida, P. H. Rolfs, Bull 127 Univ: of Florida, A.E.S.

"*Sakhar Gooty*" is almost identical with the Ceylon "HONEY" mango (Mi-Amba *Sinh.*). "*Dilpasant*" is not identical with "DILPASSAND" of South India (described in the TROPICAL AGRICULTURIST, August, 1917, page 83). The latter is not so delicately flavoured and in form characters show group relationship with the "Totapuri" order.

### OTHER NOTEWORTHY VARIETIES.

The "CAMBODIANA" is a notable variety said to be the native mango of the Malayan Peninsula. The seeds are polyembryonic. Like the "Pairi" it is a delicate sort that does not keep well and is good only for local consumption. KINMAN's notes on this are :—"The variety fruits early and is a regular and prolific bearer. The fruits are free from blemishes, uniformly coloured, very attractive and among the best in flavour and quality." This variety was introduced into America from Indo-China.

The "CARABAO" of the Philippines, characterised as "coming true from seed" belongs to this type of mango. It is, however, not so precocious. The "CECIL" which originated as a seedling from the "Philippine" mango is considered to be the handsomest and best mango of this group in Florida.

The elongated forms of the "Cambodiana" are nearly alike to the "*Totapari*" without the beak-like apex. Other forms approximate to the "*Alphonse*" with no beak and a pronounced shoulder or more nearly the "*Gola*" because of the depressed basal cavity.

The mango known in Colombo as the "JAFFNA" mango and in Jaffna as the "COLOMBO" mango is more nearly similar to the "*Cambodiana*" than to the "*Alphonse*."

The "FAJRI" of Sahranpur as described and figured by HARTLESS show strong Cambodiana affinities. HARTLESS's notes are : "The tree is of medium vigour, cold-resistant, and a shy bearer. The fruit ripens late in season and keeps well." This variety is deserving of trial at higher altitudes.

A group of mangos deserving of mention are those which go under the name of "MALDA" mangos in Calcutta. There are no descriptions available but the aroma and flavour is said to differ from all other Indian mangos. They are among the finest obtainable in India and the covering of the seed is said to be so thin that in cutting a fruit the knife often passes through the seed. WOODROW gives "LANGRA" as a synonym of the "Malda" mangos. The "LANGRAS" described by HARTLESS are among the best varieties in India and are well worthy of introduction for trial in higher elevations. They are in form similar to the "Pairi" mangos. The "CALCUTTA" mango which belongs to the same order suggests an interesting linkage of all these types to the Bombay "Pairi." It is probable that a well-extended inquiry will place the "PAIRI" order of mangos as the most widely distributed class throughout India and not the ALPHONSE order, as is generally believed.

The "KOHITOOR" is another mango that is not described anywhere. As "the premier mango in Murshedabad" it is worthy of mention in any list of the superior Indian mangos that are deserving of introduction into Ceylon.

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## A NEW CITRUS FRUIT.

A new citrus fruit with a pink flesh and sweet flavour, provisionally called a New Tangelo, has been produced by crossing in Florida. A remarkable feature of this cross (which is not unlike an orange), is the absence from the rind of any bitter principle or pungent oil, the rind itself being very mild and edible. This fruit should lend itself to the preparation of candied sections, rind and all being preserved in this form. For further information see the JOURNAL OF HEREDITY for April, 1921.—INDIAN SCIENTIFIC AGRICULTURIST, VOL. III, No. 1.

# GRAPE VINE CULTIVATION IN MICHAELPATTI.

P. PONNUSAMY NAIDU,
*Asst. Agricultural Demonstrator, Dindigul.*

## SOIL AND MODE OF CULTIVATION.

Red loamy soil with a slight admixture of lime stone or gravel is considered best suited for grape vine cultivation. Experienced ryots say that vine grown in gravelly soil tastes sweet, but in colour is not so nice as when grown in other soils (i.e.), grapes from Krishnagiri are nice to look at but not so luscious and sweet.

## PLANTING.

Pits 3 ft. × 3 ft. × 3 ft. are dug at distances of 15 feet and filled with cattle manure and loose soil which are left to decompose for some months. Then young plants (i.e.), fresh cuttings about 10 inches long from the healthy and vigorous plants 5 to 7 years old or young plants which have been previously cut and propagated in mud pots with soil mixed with some manure are planted. During the first two years the intervening spaces are generally cultivated with crops like chillies, onions which require moisture and which give the tender plants necessary shade. The young plants are placed in the pits in cool months of December and January a little after the heavy rains have ceased.

## GROWTH.

The plants attain to a height of 4 to 5 feet when about a year old; until then sticks about 1 inch are placed by the side of the plants to support them. In the beginning of the second year the plants begin to spread when light temporary pandals are put up on which the branches creep.

## PANDALS.

Pandals are put up in the third year. They are of green mullukiluvai poles (*Balsamodendron berryi*) and are 12 feet apart. Slender agathi or pekkarumbu poles (*Saccharum arudinaceum*) are thrown across and fastened by aloe fibre. The mullukiluvai is chosen as it costs little, strikes root quickly, as its roots do not spread and above all as it affords nice shade to the tender creeping branches. Once in two years the agathi poles (laid across for the support of branches) are removed at the time of pruning. The pandal is about 5 feet raised from the ground level.

## AFTER CULTIVATION.

This consists in weeding and hoeing. Hand hoeing is done at all times whenever necessary. But hoeing with mamooty is done only once in three months.

## PRUNING.

This is done generally twice a year. From the third year vine branches are pruned just when old leaves fall making room for new shoots to come. The first pruning is done during winter season (i.e.), last week of December. In the third week after pruning new shoots come and by the 5th week the flowers make their full appearance. For about 10 days after pruning vines are not watered, but from the time the new shoots make their appearance vines are regularly watered on every alternate day. The vine comes to yield during the month of March and by the end of March it is ready for harvest, i.e., gathering. Then a complete rest is given from April to May. It is during this season the vine crop is being manured. The second pruning takes place during summer season from the middle of June. Then the crop would be ready for harvest by the beginning of October. Then as usual there is a resting season from the middle of October to the middle of December.

## YIELD.

The summer yield is generally heavy and ryots get 5 to 6 rupees per maund. The winter yield is poor and is about less than half the summer yield and fetched 3 to 5 rupees per maund in normal conditions. An average-sized healthy vine yields 3 maunds under best conditions in one season.

—JOURNAL OF THE MADRAS AGRIC. STUDENTS' UNION, VOL. IX, No. 2.

# FOODSTUFFS.

## COWPEAS UTILIZATION.

W. J. MORSE,

*Agronomist, Office of Forage Crop Investigations.*

The following is extracted from FARMERS' BULLETIN 1553 of the United States Department of Agriculture :—

### THE PRINCIPAL USES OF COWPEA.

The Cowpea* is of ancient cultivation for human food, particularly in Africa and Asia, and also in the Mediterranean region of Europe. In the United States it has been grown mainly for soiling, hay, ensilage, and pasturage for all kinds of stock, and as a soil-improving crop, but in Southern States the seeds, chiefly of the Blackeye and White varieties, have been commonly used for human food.

For feed the cowpea is especially valuable because it will grow on all types of arable soil. It requires little attention but produces most excellent forage. In addition it is of great value as a green manure crop to increase the humus and the nitrogen content of the soils upon which it is grown. It also aids much in keeping the soil in good tilth and maintaining its productiveness.

### COWPEA FOR SEED.

In the United States cowpea is grown mainly as a forage, and therefore little effort is made to harvest seed. The principal factors in making the cowpea an undesirable crop to grow in a commercial way for seed production are the uncertainty of a seed crop, the expenses of harvesting and the low yields generally obtained. However, the value of the crop for forage and soil improvement and the high price of seed make it highly desirable for every farmer to grow sufficient seed to supply at least his own needs.

The demand for seed of well-known varieties has kept the prices in recent years so high as to make cowpea seed production a profitable line of farming

Cowpea seed has a high feeding value, and is a very palatable and ut ritious human food.

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* Cowpea=*Vigna catjang*. Sinhalese *Mè* ; Tamil *Paithanga*.

## TIME OF HARVESTING.

Cowpeas ripen so unevenly that it is difficult to judge just what is the proper stage of maturity to cut for seed. With nearly all varieties, blossoms and green and ripe pods occur at the same time.

In harvesting cowpeas for seed the vines should be allowed to mature a greater percentage of pods than when cut for hay. In general the crop should be harvested when one-half to two-thirds of the pods are matured. Although some loss will occur as a result of over-ripe pods shettering the seed, more seed will be obtained than if the crop is harvested before a large percentage of pods are ripe.

## METHOD OF HARVESTING.

Various methods of harvesting the cowpea for seed are employed in different sections of the cowpea region. Hand-picking is the most common way of saving the seed, although the most expensive and laborious.

Another method of harvesting by hand is to pull up the vines or to cut with a corn knife or sickle. The vines are placed in small shocks and left in the field until well cured. This method is slow and only practicable where the acreage is small.

In the United States where large fields are grown for seed production, various machines are used for cutting the vines. Several types of bean and pea picking machines are on the market, but are not extensively used.

## METHODS OF THRASHING.

The ordinary grain separator can be adjusted to thrash cowpeas successfully and it is the machine most generally used. Several modifications of thrashing machines have been devised for handling cowpeas.

## STORAGE OF SEED.

Cowpea seed, if good, can be stored for a considerable length of time without much danger of loss of vitality. If the peas are sufficiently cured in the field, mow, or stack before thrashing, there is little danger of heating. However, seed not properly cured or stored quickly loses its vitality; consequently a germination test is always advisable.

Cowpea seed is subject to attack from insects, especially the cowpea weevil. There are usually some weevils in the seed when thrashed and placed in storage, and in a warm temperature they emerge and lay their eggs upon the other stored seed.

The following table gives the results of germination tests with seeds of

different varieties kept for 4, 7, and 10 years in a store-room :—

**Germination of seed of standard varieties of cowpeas when stored for different periods.**

| Variety | | | Length of time seed was stored | | |
|---|---|---|---|---|---|
| | | | 4 years | 7 years | 10 years |
| Whippoorwill | ... | per cent | 96 | 93·5 | 79·5 |
| New Era | ... | do | 73 | 61 | 18 |
| Iron | ... | do | 60·5 | 17·5 | 14·5 |
| Clay | ... | do | 38 | 8 | 1·5 |
| Black | ... | do | 79 | 82 | .. |
| Taylor | ... | do | 50 | 26·5 | 0 |
| Blackeye | ... | do | 22 | 3·5 | 0 |
| Red Ripper | ... | do | 3·5 | ·5 | 0 |
| Groit | ... | do | 0 | 0 | 0 |
| Michigan Favourite | ... | do | 0 | 0 | 0 |
| Extra Early Blackeye | ... | do | 0 | 0 | 0 |

Cowpea seed more than 2 years old ordinarily has lost much of its viability. Good viable seeds are uniformly bright coloured, while seeds which have been exposed to moisture or are dead are duller and darker in colour.

## PROPORTION OF SEED TO HULLS.

In view of the fact that gathering the pods by hand is very generally practiced, the proportion of seeds to pods is a matter of importance. The results obtained at different experiment stations indicate that the proportions of seed and hulls vary according to the variety and locality as shown in the following table :

**Weight of Seed in 100 pounds of pods of standard varieties of Cowpeas.**

| Variety | | | Alabama | Arkansas | Arlington Farm, Va. |
|---|---|---|---|---|---|
| Whippoorwill | ... | pounds | 73 | 67·3 | 65·2 |
| New Era | ... | do | 73 | 61·8 | 67·8 |
| Groit | .. | do | — | — | 63·1 |
| Brabham | ... | do | — | — | 69·2 |
| Iron | ... | do | 69 | 65·3 | 66· |
| Clay | ... | do | 67 | 58·3 | 63·5 |
| Wonderful | ... | do | 70 | — | — |
| Red Ripper | ... | do | 71 | 66 | 67 |
| Taylor | ... | do | 77 | 64·7 | 72 |
| Large Blackeye | ... | do | 77 | 71·2 | 76·3 |
| Extra Early Blackeye | ... | do | 76 | 75 | 72·3 |
| Black | ... | do | 76 | 73·2 | 71·7 |
| California Blackeye | ... | do | — | — | 73·3 |
| Early Buff | ... | do | — | — | 73 |

## FEEDING VALUE OF COWPEAS.

The composition of cowpea seed indicates that it is of high feeding value in comparison with other feeding stuffs. Cowpeas have been used at

the Alabama Agricultural Experiment Station for fattening pigs with excellent results. Excellent results have also been obtained by feeding cowpea seed, either whole or cracked, to poultry.

**Digestible nutrients of cowpea seed in Comparison with those of other feedstuffs.**

| Feeding stuff | | | Digestible Nutrients in 100 pounds | | | |
|---|---|---|---|---|---|---|
| | | | Protein | Carbohydrates. | Fat | Total |
| Cowpea | ... | pounds | 19·4 | 54·5 | 1·1 | 76·4 |
| Canada pea | ... | do | 19·0 | 55·8 | ·6 | 76·2 |
| Soy bean | ... | do | 30·7 | 22·8 | 14·4 | 85·9 |
| Wheat bran | ... | do | 12·5 | 41·6 | 3·0 | 60·9 |
| Oats | ... | do | 9·7 | 52·1 | 3·8 | 70·4 |
| Wheat middlings | ... | do | 15·7 | 52·8 | 4·3 | 78·2 |
| Velvet bean | ... | do | 18·1 | 50·8 | 5·3 | 80·8 |
| Corn | ... | do | 7·7 | 66·1 | 4·6 | 84·2 |

## COWPEAS FOR HUMAN FOOD.

The cowpea is generally known as a food in the Southern States of America. Its limited use in the dietary of other parts of the United States is due chiefly to the fact that the culture of the cowpea has been confined principally to the South. No great effort has been made to create a general market, and competition with the navy or field beans in the North has not been developed. It is a most wholesome and nutritious foodstuff, from which a great variety of palatable as well as economical dishes can be made.

Cowpeas are used in three forms for human food—in the pod, shelled green, or shelled dried. In these forms they correspond, respectively, to string beans, shelled green peas, and dried navy beans and call for much the same methods of preparation for the table.

Undoubtedly the cowpea is of the greatest palatability from the time the pods begin to turn yellow until they begin to shrink in ripening. At this stage they are much larger than when fully mature and dry, are more easily cooked, and of better flavour. The colour of the seed has much to do with the popularity of the cowpea for table use. The White varieties, such as the Conch, Cream, or Lady, and the Blackeye varieties, such as the California Blackeye and Large Blackeye are preferred to the coloured varieties.

## YIELDS OF SEED.

The yield of seed, like that of hay, depends to a very large extent upon conditions of weather, soil, culture, and variety. In many sections the cowpea is rather an uncertain crop, as the yield of seed varies greatly from year to year. The seed yields of the most important commercial varieties reported by investigators at various agricultural experiment stations are shown in the following table. In general, the figures show the average yields for a number of years and indicate the best seed-producing sorts :

**Yield of seed to the acre of the best varieties of cowpeas at different Agricultural Experiment Stations.**

| Variety | Average yield of seed per acre (bushels) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alabama | Louisiana | Arizona | Arkansas | Delaware | Georgia | Indiana | Kansas | Mississippi | Missouri | North Carolina | Oklahoma | South Carolina | Taxas | Virginia |
| Black | 21·1 | 13·0 | — | 15·7 | 7·4 | 19·9 | 8·1 | 11·1 | 14·2 | 18·6 | 12·9 | — | 13·0 | 20·3 | 20·0 |
| Brabham | — | — | — | — | — | 11·1 | — | — | 29·1 | — | 10·0 | — | — | 4·0 | 10·6 |
| Clay | 10·8 | — | — | 9·8 | 6·6 | 34·3 | 5·3 | 10·9 | 14·0 | 14·4 | 13·7 | — | 13·3 | 2·1 | — |
| California Blackeye | — | — | — | — | — | 5·9 | — | 4·1 | — | — | — | 8·1 | 16·3 | — | 16·3 |
| Early Buff | — | — | 2·4 | — | — | — | — | — | — | — | — | — | — | 12·6 | 19·7 |
| Extra Early Blackeye | 16·4 | — | — | 29·1 | 5·4 | — | 14·2 | 9·9 | — | — | 9·2 | — | 9·9 | 7·2 | 18·8 |
| Groit | — | — | — | — | 8·2 | — | — | — | 26·8 | 14·8 | 17·3 | 2·2 | — | 8·3 | 27·3 |
| Iron | 14·9 | 5·0 | — | — | 7·4 | 15·8 | 7·2 | 2·5 | 14·8 | 17·5 | 8·3 | 3·3 | 9·3 | 14·3 | 10·9 |
| Large Blackeye | 17·0 | 6·0 | — | 23·6 | 5·6 | 31·3 | — | 12·7 | 17·1 | 14·8 | 21·7 | — | 21·7 | 17·0 | 26·3 |
| Michigan Favourite | — | — | — | — | 8·2 | — | 19·3 | 11·2 | — | 11·4 | 7·9 | — | — | — | 19·8 |
| Monetta | — | — | 6·4 | — | — | — | — | — | — | — | 10·9 | — | — | 1·3 | 13·2 |
| New Era | 22·0 | 18·7 | — | 39·9 | 15·6 | 6·9 | 14·0 | 12·4 | 22·3 | 14·0 | 14·7 | 5·0 | 24·2 | 9·6 | 25·2 |
| Red Ripper | 19·3 | 4·5 | — | 11·9 | — | 27·7 | — | 7·9 | 14·2 | 8·3 | 14·2 | 2·0 | — | 2·7 | — |
| Taylor | 23·6 | — | — | 19·9 | 4·9 | 11·3 | — | 11·9 | 21·7 | — | 10·6 | 2·4 | 11·5 | 9·7 | 18·6 |
| Unknown | 14·7 | — | — | 2·5 | 3·5 | 30·5 | — | ·5 | 10·0 | — | 4·4 | 1·5 | — | 13·4 | — |
| Whippoorwill | 12·4 | 12·7 | — | 25·6 | 13·2 | 25·3 | 18·3 | 11·5 | 28·5 | 14·0 | 14·8 | 1·0 | 13·8 | 16·5 | 10·1 |

## COWPEA STRAW.

The straw obtained from thrashing the cowpea for seed is a valuable feed for all kinds of stock. Although no data from feeding tests with this straw are available, farmers and liverymen who have used it claim that it is an excellent feed, some even preferring it to cowpea hay. No ill effects have been reported from its use. The following table gives the digestible nutrients of cowpea straw in comparison with those of the straw of other crops commonly used for feeding :—

**Digestible nutrients of cowpea straw compared with those of the straw of other important crops.**

| Kind of Straw | | Digestible nutrients in 100 pounds | | | |
|---|---|---|---|---|---|
| | | Protein | Carbohydrates | Fat | Total |
| Cowpea ... | pounds | 3·4 | 39·1 | 0·7 | 44·1 |
| Soy bean ... | do | 2·8 | 38·5 | 1·0 | 43·5 |
| Oat ... | do | 1·0 | 42·6 | 9 | 45·6 |
| Wheat ... | do | 0·7 | 35·1 | 0·5 | 36·9 |
| Rice ... | do | ·9 | 37·8 | ·3 | 42·8 |
| Barley ... | do | ·9 | 40·2 | ·6 | 42·5 |

## COWPEAS FOR HAY.

If cut at the right stage of growth and properly handled, cowpeas make excellent hay of high feeding value. This hay is greatly relished by all farm animals. Well-cured cowpea hay has proved satisfactory for work stock and for beef or milk production. It has also given good results when fed to poultry, hogs, and sheep. Cowpea hay is said to be better suited for feeding cows than horses.

## TIME AND METHOD OF CUTTING.

Cowpeas should not be cut for hay before the pods begin to turn yellow. The best quality is produced and the hay cures most readily if the vines are cut when most of the pods are full grown, and a considerable number of them are mature. If cut before this stage, the vines are watery and difficult to cure.

The ordinary mowing machine is the most practical machine for cutting cowpeas for hay, but scythes are also sometimes used in harvesting small areas.

## CURING COWPEA HAY.

Many special devices are used more or less in curing cowpea hay. The most common of these is a pole, usually with crosspieces nailed at right angles, around which the vines are placed. Triangular frames from 2 to 3 or more feet high, built of poles with crosspieces to hold them together, are used to some extent in the same manner. The object of these devices is to keep the vines from becoming too tightly packed and to have an air space in the centre of the cock. These devices give excellent results in curing cowpeas, but, on account of the increased cost and labour involved, are not in general use.

Another method successfully practiced in some localities is that of placing the vines on poles or frames as soon as cut. The vines will form a good surface to shed water and should be left to stand two or three weeks, or until ready to stack.

The use of salt has been recommended by many successful growers. Although not essential, undoubtedly the hay is improved in palatability and it may, in the case of hay not entirely cured, assist in preventing fermentation. About 8 quarts of salt are used to 1 ton of hay.

## FEEDING VALUE OF HAY.

The chief value of cowpea hay lies in its high percentage of digestible protein, which has been verified by numerous feeding tests. The following

table gives comparative analyses of important hay crops :—

**Analyses of cowpea hay and other important hay crops.**

| Kind of Hay | Constituents (per cent). | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Fat | Nitrogen free extract | Ash | Fibre |
| Cowpea | 10·4 | 16·1 | 3·2 | 40·3 | 10·2 | 19·8 |
| Soy bean | 8·4 | 15·9 | 3·9 | 38·8 | 8·9 | 24·1 |
| Alfalfa | 8·7 | 15·9 | 2·7 | 36·8 | 8·8 | 27·1 |
| Timothy | 13·2 | 7·1 | 2·8 | 43·3 | 5·4 | 28·2 |
| Red clover | 12·9 | 13·6 | 3·4 | 39·1 | 6·9 | 24·1 |

## COWPEAS FOR SOILING.

Cowpeas can be utilized to good advantage as a soiling crop. With its high percentage of protein it is an excellent supplement to less nitrogenous crops, such as corn, sorghum, and millet. The wide variation in the maturity of the varieties makes it possible to have an abundance of green forage throughout the greater part of the summer and fall.

## COWPEAS FOR SOIL IMPROVEMENT.

The cowpea has been used as a restorative crop more than any other leguminous crop, especially throughout the Southern States. It is so easily grown and has such a marked effect on the succeeding crops that its use should be greatly increased. Aside from increasing the productiveness of the soil, the cowpea also improves its general physical condition, making heavy clay soils more open and sandy soils more compact. The cowpea has the distinct advantage of making a good growth on soils that will not produce profitable yields of other legumes or cereals. It is an excellent green-manure crop for vineyards and orchards.

The results of analyses made by the North Carolina Agricultural Experiment Station show that 1 ton of cowpea hay contains 47 pounds of nitrogen, 10 pounds of phosphoric acid, and 29 pounds of potash. The following table gives the fertilizing materials in 100 pounds of dry substance of legumes commonly utilized for soil-improving purposes :

**Fertilizing constituents in 100 pounds of dry substance of the tops and roots of important legumes.**

| Plant and Part | | Nitrogen | Phosphoric | Potash |
|---|---|---|---|---|
| Red clover : | | | | |
| Tops | pounds | 2·35 | 0·58 | 2·14 |
| Roots | do | 2·74 | ·84 | ·82 |
| Alfalfa : | | | | |
| Tops | do | 2·30 | ·54 | 1·52 |
| Roots | do | 2·04 | ·43 | ·48 |
| Crimson clover : | | | | |
| Tops | do | 2·13 | ·62 | 1·35 |
| Roots | do | 1·50 | ·47 | 1·02 |
| Cowpea : | | | | |
| Tops | do | 1·96 | 0·51 | 1·93 |
| Roots | do | 1·18 | ·55 | ·93 |
| Soy bean : | | | | |
| Tops | do | 2·18 | ·61 | 1·68 |
| Roots | do | 1·05 | ·34 | ·67 |
| Velvet bean | do | 2·51 | ·53 | 3·84 |
| Common vetch | | | | |
| Tops | do | 2·99 | ·71 | 2·68 |
| Roots | do | 2·19 | ·79 | 1·18 |

# PROPAGATION OF THE BREADFRUIT IN ST. LUCIA.

The following notes on the propagation of the seedless breadfruit by root cuttings, have been furnished this Department by MR. A. J. BROOKS, Agricultural Superintendent, St. Lucia:—

In an article which appeared in No. 3, Vol. XIII, of the PHILIPPINE AGRICULTURAL REVIEW, attention was directed to the value of the breadfruit as a means of lessening the food shortage experienced during certain periods of the year, and also to the practicability of propagating this seedless plant from dormant roots, by the production of adventitious buds.

The article referred to states: "The observation of the formation of adventitious buds on injured roots of the breadfruit tree led the writer to conduct a series of experiments with root cuttings in 1913, during which it was found that properly handled, and made at the right time, the rooting of cuttings was a very simple matter. Directions how to proceed were subsequently published, but various correspondents who have tried the method have failed to obtain good results, hence it has seemed desirable again to discuss the subject more in detail."

The writer then gives details how to proceed.

A trial was made along the lines suggested, at the Agricultural Station, Reunion, and the results are here recorded.

A full-grown tree was selected in May, when the plant was in a dormant condition owing to the prolonged drought. Four medium size roots were carefully exposed and severed from the tree. These, when cut into lengths of about 6 inches, made ninety-five root cuttings.

These were inserted in nursery beds, the soil being first covered to a depth of 3 inches with sea sand.

Four weeks after insertion, bud formation was observed. At the end of September—four and a half months from the time the cuttings were made—fifty-eight had developed into strong vigorous plants between 6 and 7 inches in height; thirty-five of the remaining cuttings had produced numerous buds, and small white shoots which had not commenced to grow erect, and only two were actually dead.

The fifty-eight plants have now been planted out in permanent situations at Reunion, and the remainder will be treated in the same way when strong enough.

This trial conclusively proves that the seedless breadfruit can be readily propagated in the manner described, and with very little trouble.

There is no doubt that the annual food shortage experienced in Saint Lucia during the months of June to October, could be considerably reduced, if more attention were given to the question of planting breadfruit trees in suitable localities throughout the Colony.

While some planters find in the breadfruit a remunerative crop, others contend that such trees are an abomination, as it supplies the labourer with a cheap food and thereby reduces the necessity for him to work. For this reason alone, breadfruit trees have in some cases been deliberately destroyed. Under these circumstances it is very doubtful if planters in this island will be willing to assist in extending the distribution of this most useful economic plant.—AGRIC. NEWS, VOL. XX, No. 509.

# CEYLON AGRICULTURE.

## MINUTES OF MEETING OF ESTATE PRODUCTS COMMITTEE.

*Minutes of the 6th meeting of the Estate Products Committee of the Board of Agriculture held at the Experiment Station, Peradeniya, at 2-30 p. m. on Thursday, January 12th, 1922.*

*Present:*—The Director of Agriculture (Chairman), The Government Botanist and Mycologist, The Government Agricultural Chemist, The Government Entomologist, The Assistant Botanist and Mycologist, The Assistant Entomologist, Messrs. H. D. Garrick, J. B. Coles, John Horsfall, J. A. Coombe, W. R. Matthew, A. J. Austin Dickson, Neill G. Campbell, J. S. Patterson, M. L. Wilkins, J. P. Blackmore, C. E. A. Dias, Thomas A. de Mel, A. W. Beven, Graham Pandittasekera, C. P. de Silva, N. D. S. Silva, F. R. Senanayake, The Hon'ble Mr. Græme Sinclair, The Hon'ble Mr. O. C. Tillekeratne, Gate Mudaliyar A. E. Rajapakse, Dr. C. A. Hewavitarne, Major J. W. Oldfield, O.B.E., M.C., and Mr. T. H. Holland, M.C. (Secretary).

*Visitors:*—Messrs. A. W. Waldock, G. Harbord, M. Park, C. H. Gadd, T. B. Ranaraja, and Major R. T. Holland, D.S.O., M.C.

Letters and telegrams regretting inability to attend were read from Sir Solomon Dias Bandaranaike, Lt.-Col. L. Bayley, Lt.- Col. T. G. Jayawardene, The Government Agents, Western, Central and Northern Provinces; The Hon'ble Mr. H. L. De Mel, C.B.E., the Hon'ble Mr. James Peiries and Mr. A. S. Long Price.

The minutes of the last meeting having been circulated to members were taken as read.

**Agenda Item 1. Progress Report of the Experiment Station, Peradeniya.**

The CHAIRMAN reviewed and commented on items of interest in the report.

With reference to the girth measurements of rubber trees planted by different methods Mr. J. B. COLES asked how many trees per acre were given by the Avenue method which had given the best growth.

The figures worked out to 105 trees per acre against 109 when planted 20 ft. × 20 ft.

MR. SHERIDAN PATTERSON asked if thinning out so as to isolate trees in groups of four was recommended.

The CHAIRMAN replied that it was difficult to say, many factors had to be taken into consideration.

Referring to the samples of coffee to be sent to England for valuation Mr. NEILL CAMPBELL asked how they were cured as this had an important bearing on their value.

The CHAIRMAN replied that the samples from all varieties would be cured in the same manner.

Before passing on to the next item the CHAIRMAN exhibited some photographs of the cotton being grown by Government at Ambalantota and remarked that the crop was doing very well at present.

The Sea Island cotton was looking best, then the Cambodia, but other varieties were doing well. If favourable weather was now experienced a good crop should be obtained.

MR. M. L. WILKINS enquired if any disease was present.

The CHAIRMAN replied that very little trouble had been experienced from disease up to the present time.

MR. WILKINS asked what crop was expected.

The CHAIRMAN replied that he hoped for a crop of 7 cwt. of seed cotton per acre. The cotton had been planted on 10th October since when only 12 inches of rain had fallen; this had not been quite sufficient for early growth but if the weather was now favourable the prospects were good.

MR. TILLEKERATNE then proposed changing the dates of the meetings of the Committee to the 2nd Saturday or Monday in the month in order to avoid the dates coinciding with the meetings of the Legislative Council as they did under the present arrangement.

MR. GRÆME SINCLAIR said that busy men had now so many meetings to attend to and he thought it an advantage for the meetings to coincide; members of both bodies could then attend whichever meeting had business of particular importance to discuss.

MR. C. E. A. DIAS advocated holding alternate meetings in Colombo. More visitors would be present at the Colombo meetings.

The CHAIRMAN said that this subject had been discussed before; the second Thursday in the month had been fixed for the convenience of the planting members. He had had no notice of the subject on this occasion and suggested circularising members asking for their opinions and summarising the replies at a subsequent meeting.

MR. TILLEKERATNE agreed to this.

**Agenda Item 2.—Chilaw Coconut Experiments. Report of Sub-Committee.**

MR. M. KELWAY BAMBER, the CHAIRMAN of the Sub-Committee, read a report giving certain recommendations for the continuation of the experiments with modifications. The report further recommended that one or more series of additional experimental plots were desirable on soil more completely representative of large coconut areas. One should be on typical sandy soil in the Chilaw district and one on typical soil in the Kurunegala district.

The CHAIRMAN enquired if additional manurial experiments were intended.

MR. BAMBER replied in the affirmative.

GATE MUDALIYAR A. E. RAJAPAKSE said that he had originally suggested the abandonment of the present experiments on account of the unsuitability of the ground. He had come to know later that Government had leased the land in question for 25 years. He had seen MR. MARTIN, the proprietor, and he was quite ready to come to an arrangement about the land. MUDALIYAR RAJAPAKSE also suggested that some tillage experiments should be started. He agreed with the Sub-Committee's suggestions that deep drains should be dug between the plots and that fresh experiments were desirable.

Mr. T. A. DE MEL agreed and expressed himself in favour of abandoning the present experiments. He thought that all the experimental plots should be divided into three, one sub-plot to be manured, one for green manuring or tillage and one as control. He thought that fresh experiments should be started.

MR. C. E. A. DIAS said that he had only seen the copra figures from the experimental plots after the Sub-Committee had completed their deliberations. He suggested a postponement of the question to enable these figures to be examined.

MR. KELWAY BAMBER then read out the copra figures referred to.

It appeared that Bone meal had the greatest effect in decreasing the number of nuts per candy and next to this Fish Guano. Following the short rainfall in 1917 and 1918 all plots showed an increase in the number of nuts per candy.

It was agreed that these figures should be published.

MR. NEILL CAMPBELL remarked that the crops were not given ; a big crop always meant more nuts per candy.

MR. GRÆME SINCLAIR opposed the further sub-division of the acre plots on the ground that reliable figures would be harder to obtain.

MR. C. P. DE SILVA remarked that on his estates where cattle manure was used the number of nuts per candy was never above 1000. His yield was about 65 nuts per tree.

The CHAIRMAN said that he was anxious to come to a decision on the matter. The Sub-Committee had submitted a report and he would like the meeting to adopt or amend this report. The manures which had been due to apply in October 1921 had not yet been applied pending a decision on the matter.

MR. T. A. DE MEL said that if a control plot to each manured plot was not feasible then all the plots must be even.

MR. J. B. COLES and MR. H. D. GARRICK opposed the further sub-division of the plots and were of the opinion that in most experiments undertaken in the past the plots had been too small.

MR. DIAS said that on account of the unevenness of the land it was necessary to provide a control plot for each plot.

MR. COLES said that the ground was unsuitable and a fresh start should be made elsewhere.

MR. KELWAY BAMBER stated that MR. MARTIN thought that the plots were representative of a large area of coconut land in that district. He thought the experiments were well worth continuing but did not consider the soils fully represented the Negombo or Chilaw coconut soils. Experiments were desirable in the Kurunegala or Chilaw districts and offers of land had been made. It was however very difficult to select a really even block of coconuts partly on account of the custom of continually supplying vacancies with young plants.

MR. AUSTIN DICKSON emphasised the importance of experimental plots being under observation for at least one or two years before the manures were applied.

The CHAIRMAN agreed and said that it had been demonstrated all over the world with permanent crops that it was necessary to ascertain first the natural yield of the various plots used for experimental purposes. He did not favour the Sub-Committee's suggestion to sub-divide the plots.

MR. A. W. BEVEN said that he understood a final meeting of the Sub-Committee had been intended and had not taken place.

MR. GRÆME SINCLAIR proposed and MR. SHERIDAN PATTERSON seconded that the Sub-Committee's report be adopted except the scheme for the subdivison of plots.

MR. T. A. DE MEL, seconded by MR. C. E. A. DIAS, proposed as an amendment that the matter be referred back to the Sub-Committee.

MR. DE MEL'S amendment was carried, 8 voting for and 7 against.

MR. GRÆME SINCLAIR proposed that his place on the Sub-Committee should be taken by LT.- COL. T. Y. WRIGHT. This was agreed to.

**Agenda Item 3.—(a) The Improvement of the Quality of nuts by Manuring.**

**(b) Why on certain Estates does the Quality of Coconuts differ largely though the Soil analyses are the same.**

MR. C. E. A. DIAS who introduced this subject said that it appeared to be a fact that the larger the number of nuts per acre the larger the number of nuts per candy of copra. Was it not possible to increase both the number and quality of nuts. He quoted from a table giving figures, yields of nuts, number of nuts per candy and soil analyses from 4 estates.

MR. KELWAY BAMBER said that no doubt manures did affect the quality of nuts, the Bone meal and Fish guano appeared to have done so at Chilaw. He quoted an extract from the JOURNAL OF AGRICULTURAL RESEARCH showing that climate was the great factor in causing variation in the quality of nuts.

MUDALIYAR RAJAPAKSE said that buyers paid more for nuts from well cultivated estates. He quoted figures giving weights of copra from individual nuts ; in some case this fell as low as 4 oz. the weights ranged from 4 to 10 oz.

The CHAIRMAN said he had seen photographs which showed that different varieties of nuts varied largely in their copra content but the Chilaw figures indicated that climate was the great controlling factor though possibly manuring had some effect. It was a difficult problem.

MR. DIAS thought that the Department should study the question of good yielding trees as was being done in the case of rubber.

The CHAIRMAN promised at a future meeting figures illustrating differences in varieties of coconuts. The subject was being investigated.

**Agenda Item 4. The Desirability of Experiments to Ascertain the Soil Constituents removed annually by a crop of Nuts and by Toddy.**

MR. A. W. BEVEN in introducing this subject said that it was the custom to tap trees for a certain number of months and then rest them. He gave different periods employed in different districts. In Galle trees were tapped for nine months and rested for three, in Negombo for 8 months and rested for 16 months : in Chilaw tapping alternate years was employed. An Excise officer had informed him that continuous tapping of trees caused tapering. Sometimes trees were tapped with the object of making them bear.

The CHAIRMAN said that a great deal of investigation would be required. He promised to consult with MR. BAMBER as to what could be done in the matter.

**Agenda Item 5. Leaf Break on Coconut Palms.**

MR. SHERIDAN PATTERSON enquired if anything more had been discovered with regard to this disease.

MR. PETCH in reply said that MR. GADD had been investigating the disease. Diplodia was the only fungus that had been discovered in affected leaves and was therefore presumed to be the cause of this disease although inoculation experiments had given no results.

The disease was not regarded as serious. The remedy recommended was cutting off the affected leaves.

MR. PATTERSON said that it was prevalent in young plantations and in this case cutting of leaves was rather a serious consideration.

The CHAIRMAN said that MR. GADD had been concentrating on coconut diseases for the last year and a statement on the subject would be ready shortly.

MR. DIAS commented on the large amount of damage done to leaves by the Black beetle. He was sure that the Pest was on the increase in Colombo and thought that the Department should take the matter up.

The CHAIRMAN promised to consider the matter.

**Agenda Item 6. Shot-hole Borer of Tea.**

The CHAIRMAN asked MR. JEPSON to give a resumé of replies received to the circular postcard recently sent out to infested estates asking for information as to the spread of Shot-hole Borer.

MR JEPSON exhibited specimens of the postcards sent out. He had hoped for at least 80% replies but only 73% had been received.

The three questions asked were as to (1) the intensity of attack on estates infested for some time. (2) The spread to previously unaffected portions of the estate and (3) the spread in the district.

He read a report analysing the opinions received and drew the conclusion that the statement that the borer was on the increase and was spreading to higher elevations was not borne out by the replies received.

MR. PATTERSON said that the serious point was that it was spreading to new districts.

MR. T. A. DE MEL thought that it was spreading to higher elevations.

MR. JEPSON pointed out that his report had of necessity been based on replies received. In the case of Ratnapura for instance the majority of the cards sent had not been returned.

MR. J. B. COLES said that he had seen Shot-hole Borer in Morawak Korale 5 or 6 years ago but he did not think it was spreading.

MR. JOHN HORSFALL asked what percentage of replies had been received from the Haputale district.

MR. JEPSON replied that 38 out of the 43 had been received.

MR. AUSTIN DICKSON enquired if any more results had been obtained at Sarnia.

The CHAIRMAN said that the report on the burial of prunings experiment would be ready for the next meeting. Further observations were needed in the case of the manurial experiments which had not yielded much result yet.

**Agenda Item 7. Tobacco Experiments at Teldeniya.**

The CHAIRMAN said that the object of the experiments was to find out if a good cigar type could be grown in the Teldeniya district. He asked MR. HARBORD, who was in charge of the experiments, to review the position. All the reports on the tobacco were not yet available. Reports from India were awaited as the tobacco was too heavy and coarse for the English market.

MR. HARBORD read extracts from and commented on the report. The tobacco grown were chiefly American. Maryland Mammoth and Halladay's Hybrid had been the most successful varieties.

The CHAIRMAN said that quite good cigars could be produced at Teldeniya. It was largely a question of manufacture. As a rule tobacco was insufficiently cured. This had been got over and a very fair cigar was now obtained. The endeavour was to stimulate a trade in a cheap fair quality cigar in the Teldeniya district.

MR. J. P. BLACKMORE asked if manuring was recommended and said that most Teldeniya cultivators did not believe in manuring tobacco.

The CHAIRMAN replied that artificials had been used in the first year. Too much organic or nitrogenous manure would result in a coarse leaf but judicious manuring would do no harm.

MR. GRAHAM PANDITTASEKERA enquired whether Club root had given trouble.

The CHAIRMAN replied that an eelworm had been found and it was for this reason that Teldeniya cultivators did not grow 2 successive crops of tobacco on the same land.

**Agenda Item 8. Report of the Mycologist on Tea Manurial Plots.**

MR. PETCH submitted a report showing the prevalence of Red Rust and Branch canker or small stems found in the plots at Peradeniya. In the case of Red rust the only point of interest was that the disease was noticeably less in the plots under dadap shade. The fact that Algæ require light for their growth would account for this.

In the case of branch canker the disease was noticeably worse in the Assam Hybrid plots.

**Agenda Item 9. Gamboge found in Ceylon.**

MR. T. A. DE MEL said that he had heard recently that the chief clerk of the Survey Office at Badulla had discovered Gamboge. He asked for information as to the possibility of obtaining this product in Ceylon.

The CHAIRMAN said that the Department had previously had one or two enquiries regarding Gamboge. He would ask MR. PETCH to give the history of the product in Ceylon.

MR. PETCH said that gamboge is a yellow resin used in paints and also medicinally. It had no particular virtue as a medicine and could easily be replaced.

Old books state that it is obtained from Siam or Ceylon, but it is now known that none was ever put on the market in Ceylon, and that the Ceylon tree is different from the tree from which gamboge is obtained in Siam. The former is *Garcinia Morella* and the latter *Garcinia Cambodia*.

The resins are identical but easier to collect in Siam, where it will run, than in Ceylon where it has to be scraped off. The resin can also be obtained from the Mangosteen.

Before concluding the meeting the CHAIRMAN informed members that action had been taken on the Committee's recommendations with regard to Shot-hole borer legislation and the importation of Indian tea seed which was now prohibited.

Bulletin No. 51 on the disinfection of tea seed by Formaldehyde vapour was laid on the table.

T. H. HOLLAND,

Secretary, Estate Products Committee.

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# MINUTES OF MEETINGS OF FOOD PRODUCTION COMMITTEES.

## KALUTARA.

*Minutes of a Meeting of the Food Production Committee, Kalutara District, held at the Kalutara Kachcheri on the 6th December, 1921.*

*Present* :—Mr. B. G. de Glanville, Asst. Govt. Agent, in the Chair, Mr. F. H. Griffith, Mudaliyar J. J. de Mel, Mr. S. O. Felsinger, Asst. Conservator of Forests, Mr. W. N. Goonewardena, Mudaliyar D. T. Perera, Mr. J. C. Abeywardene, Agricultural Instructor, P. K. East ; Mr. D. T. J. Weerasuriya, Agricultural Instructor, Rayigam Korale and Panadura Totamune ;

Mudaliyar D. A. Emilian, Mudaliyar Edmund Peiris, Mr. Fred Burnett, Divisional Agricultural Officer, S. D. and Mudaliyar E. H. S. Karunaratne, Hony Secretary to the Committee.

The minutes of the last meeting were read and confirmed.

1. Allocation of the sum of Rs. 400 allowed by Government for competitions 1921-22. On the suggestion of MR. BURNETT, it was decided to abandon the competitions, and to devote this sum, with the sum of Rs. 200 allowed for Shows, in organising four village Shows in the four Chief Headmen's Divisions, instead of one big Show at Kalutara, as decided upon at the last meeting. The Shows will be held at the Horana (Raigam Korale), Bellana (Pasdum Korale East), Matugama (Pasdum Korale West) and Panadura or Wadduwa (The Totamunes). Each Mudaliyar to form a Show Committee, with himself as Chairman, and the Asst. Govt. Agent as Patron. The Divisional Agricultural Officer, S. D. and the Agricultural Instructors should be Ex-officio members of these Committees.

The Food Production Committee to invite the District Planters' Association to lend its support to these Shows.

2. Report of Agricultural Instructor Weerasuriya regarding the Paddy Transplanting Competition in Panadura Totamune.

3. Read and considered Bulletin on "The Cultivation of Limes." It was decided to circulate this document to the members of the Committee.

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## MATARA.

*Proceedings of a meeting of the Food Production Committee, Matara District, held at the Kachcheri on 6th January, 1922, at 3 p. m.*

*Present* :—Mr. J. D. Brown, in the chair, and the following gentlemen:—The Hon'ble Mr. F. A. Stockdale, The Hon'ble Mudaliyar O. C. Tillakeratne, Messrs. F. Burnett, G. Altendorff, J. E. Wijesinhe, E. Buultjens, Mudaliyars W. A. Amarasekere, S. W. Illangakoon, H. E. Wickremaratne, W. A. Perera, W. A. Wijesinhe, and Messrs. M. J. A. Karunanayake and B. G. Buultjens.

1. Resolved that the lecture on "Improvement to Coconut Cultivation" kindly promised by the Divisional Agricultural Officer be arranged to be delivered at the Court house on 22nd February at 4 p. m.

2. Resolved that the Government Grant of Rs. 400 be apportioned as indicated below.

(a) Rs. 300 to be voted for prizes for transplanting competition and distributed at the rate of Rs. 100 to each of the following divisions (the amount to be divided in 3 prizes of Rs. 50, Rs. 30 and Rs. 20 for each division) :—

Four Gravets, Wellaboda Pattu and Kandaboda Pattu.

(b) Rs. 100 to be allotted for the Weligama Agricultural Show.

3. Resolved to hold the Agricultural Show at Weligama in July next.

4. Resolved that the Assistant Government Agent, Divisional Agricultural Officer and Mr. E. BUULTJENS be asked to judge the transplanting competitions on the following dates :—

18th January, Kandaboda Pattu
19th January, Four Gravets and Wellaboda Pattu

5. Resolved that Mr. J. E. WIJESINGHE be asked to send for distribution among the members copies of his leaflet re Vel Vidane System.

6. Resolved that draft rules *re* organisation of Agricultural Shows etc., promised by the Director of Agriculture be circulated on receipt.

7. Resolved that the question of reducing or waiving stamp fees on gun licenses be left in the hands of the HON'BLE MUDALIYAR O. C. TILLEKERATNE who has already taken steps in the matter in the Legislative Council.

8. The Director of Agriculture offered to send free of cost Cotton seeds for experimental purposes and also agreed to make provision to defray the cost of an experimental plot of 2 acres in Wellaboda Pattu on the Mudaliyar's undertaking to carry out the experiment with the assistance of MR BURNETT.

The meeting terminated with a vote of thanks to the Chair.

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## HAMBANTOTA.

*Minutes of a meeting of the Food Production Committee, Hambantota District, held at the Hambantota Kachcheri at 2 p. m. on the 20th December, 1921.*

*Present* :—The Assistant Government Agent (CHAIRMAN), The Divisional Agricultural Officer, S.D., The Mudaliyar, Magam Pattu ; The Muhandiram, Magam Pattu ; the Chena Surveyor Muhandiram, Hambantota District ; The Kachcheri Mudaliyar (Hony. Secretary).

The Minutes of the previous meeting dated the 24th January, 1921, were read and confirmed.

Considered Divisional Agricultural Officer's Circular No. 1052 of the 13th July 1921 re crop competition, No. 1050 of 13th July, 1921 re Agricultural Shows and Mudaliyar East Giruwa Pattu's letter No. 1178 of 10th December, 1921 *re* proposed shows in East Giruwa Pattu in January next.

Resolved that each Pattu should have a Pattu Show in 1921-22 at (1) Tissa for Magam Pattu, (2) Ambalantota for East Giruwa Pattu and (3) at a place in West Giruwa Pattu to be decided later, the Mudaliyars of the respective Pattus to form their Committees for organising the shows.

Considered Divisional Agricultural Officer's letter No. 1665 of 3rd October 1921 *re* allocation of grants for competitions and shows during the year 1921-22. Resolved that the sum of Rs. 200 allocated for shows and competitions in this District be equally divided between the three Pattus.

Discussed the question of extending the cultivation of uncultivated lands in the district. (1) Resolved that the Divisional Agricultural Officers should supply, as far as possible, seed for vegetable growing on chenas if the villagers could be induced to devote a portion of each chena for growing vegetables. (2) Resolved that it is desirable to repair certain tanks at present abandoned and the Committee particularly recommend the restoration of (1) Katawewa (Lot No. 2 in F. V. P. 52.) and (2) Badagiriya, in Magam Pattu.

The Divisional Agricultural Officer moved that the Mudaliyar Magam Pattu be thanked for his services in connection with cotton growing in Magam Pattu. The motion being put to the meeting was passed unanimously.

# PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

*For November and December, 1921.*

## TEA.

All small prunings have been forked in in alternate rows with 100 lb. Basic slag and 60 lb. Sulphate of Potash per acre.

All jungle stumps and logs have been dug out and removed or burnt.

An examination of the roots of a dadap and a gliricidia tree of the same age growing side by side showed a far larger number of nodules on the roots of the latter. Those present on the Dadap roots were of a larger size.

## RUBBER.

The trees in the Hill top and Hill side rubber areas planted in June 1913 have been measured and numbered preparatory to bringing them into tapping in 1922.

The average girth of those trees are as follows :—

*Hill top rubber.*

| | | | |
|---|---|---|---|
| Group A. | Planted in clumps of 4 trees, 12 ft. × 12 ft. 40 ft. between clumps. | Average girth— | 28·5 inches |
| ,, B ,, | in avenues 15 ft. × 15 ft. 40 ft. between avenues | ,, ,, | 29·5 ,, |
| ,, C ,, | 20 ft. × 20 ft. | ,, ,, | 27·5 ,, |
| *Hill side rubber* | Planted 20 ft. × 20 ft. | ,, ,, | 27·2 ,, |

The superiority in the growth of Groups A and B is marked but it should be noted that group B is growing on flat land, Group A on a gentle slope and Group C and the Hill side rubber on steep land.

## CACAO.

Two exceptionally heavy pickings have been taken. Sale of good cacao have been effected @ Rs. 41·50 and 40·50 per cwt. The eradication and removal of stumps and logs had been completed. All the old cacao is receiving a deep forking, as many leaves as possible being buried in. This will be completed in January.

## COCONUTS.

A census of coconut trees was taken in December. There are in all 1863 trees in bearing and 375 young trees not in bearing. The yield of nuts for 1921 is 47,937 being an average of 25·7 nuts per tree in bearing. The majority of this crop was harvested from old palms scattered throughout the cacao and the old grass fields of the station.

At an auction sale in December Rs. 32·50 per 1,000 for unselected nuts was realised.

Drains have been cleaned in the Bandaratenne coconut plot.

## COFFEE.

The crop from the Robusta coffee though late in maturing is a good one.

The ages of the coffees which yields published in the last report are :—

| | |
|---|---|
| Robusta part | 11 years, part 8 years, part 7 years |
| Uganda | 6 years |
| Quillou | 6 years |
| Canephora | 5 years |
| Hybrid | 5 years |

Samples of coffee from these varieties are being sent to the Imperial Institute, London, for valuation and report.

A small experiment has been started on 3 plots of Robusta coffee with the object of comparing the results from

(1) Cattle manure and forking

(2) Heavy mulching with green material but no cultivation

(3) Plain forking.

A census was taken in December of the number of trees of each variety affected with "Die back." The result showed 41% of the Hybrid bushes were affected whilst between 75% and 86% of all other varieties were affected.

Suckers and die back branches have been pruned.

The new plots have been holed for the reception for 3 further varieties of Robusta types of coffee received from the Belgian Congo.

**PADDY.**

The old paddy area has been reploughed and sown with selected green manures to be ploughed in again before the plots are required by the Economic Botanist for the next Yala season.

The new paddy area has again been suffering from lack of water.

**ECONOMIC COLLECTION AREA.**

The formation of the new area for annual economic crops has been completed and the portion newly included has been sown with Horse grain as a green manure previous to starting new experiments in the South-West Monsoon.

**YAMS.**

22 varieties of Dioscorea yams have been dug up from the Fruit plots and replanted in plot 18. The largest weight of yams were given by the Klapa, Baeton and Angiliala varieties which produced an average of 35, 34 and 21 lb. of yams per creeper respectively.

**ROADS.**

The cutting, earth work and draining of the new road round the Economic plots has been completed.

Laying of foundation preparatory to metalling has been commenced on another portion of road.

**RAINFALL.**

Rainfall for November was 3·86 inches and for December 5·89 inches.

**LABOUR.**

A few cases of chicken-pox have occurred among the Sinhalese labour.

T. H. HOLLAND,
Manager, Experiment Station, Peradeniya.

# SOILS AND MANURES.

## AGRICULTURAL BACTERIOLOGY.*

MRS. DOROTHY NORRIS, M.Sc.,

*Agricultural Bacteriologist to the Government of Madras.*

One of the outstanding agricultural problems of the present day is the question of manures.

In Western countries, where mechanical power is rapidly replacing that of animals, supplies of natural manure are quickly diminishing, and the position is little better in this country, where much of the available farmyard manure is utilised for fuel. China and Japan on the other hand, appear to have realised the gravity of the situation and conserve every scrap of human and animal excreta for use on the land.

In view of the foregoing, it is therefore of great interest to note research work on artificial manures carried out by HUTCHINSON and RICHARDS at ROTHAMSTED. So far as can be gauged at present, this work has opened up fresh possibilities, which may revolutionise the question of manuring in the near future, for its limitations should be very quickly disposed of now that the main problem appears to have been solved.

The process may be briefly described as follows:—

It consists of the bacterial fermentation of straw or other waste cellulose containing material, in the presence of a suitable nitrogenous compound.

The three essential factors are :—

1. Air supply
2. Favourable temperature, and
3. Supply of suitable soluble nitrogen compounds.

The basic material is waste straw from any available source, and this is fermented ærobically.

The temperature rises during fermentation to 65° C. when the nitrogen supply is properly adjusted.

The reaction must be neutral, or only slightly alkaline. Hence ammonium sulphate alone as a source of nitrogen is no use, because the medium soon becomes acid.

Nitrogen must be present in an available or indirectly available form, and must not exceed a definite concentration, e.g. if ammonium carbonate from decomposition of urea is used, and exceeds a certain limit, the break down changes cease until the concentration or the alkalinity has been reduced by loss of nitrogen.

(a) If the straw is overloaded with nitrogen loss occurs

(b) If the exact amount is present the straw rots without loss

* Paper read at the Madras Agricultural Students' Union Conference, Coimbatore, 19th December, 1921.

(c) If the straw is under-saturated nitrogen, particularly in the form of Ammonia, can be picked up by the organism present.

The nitrogen appears to be stored in an organic or non-ammoniacal form.

The amount of nitrogen necessary varies from 0·70 to 0·75 pts. of nitrogen per 100 pts. straw and a stabilised product is obtained, when rotting has proceeded to 40%, which usually possesses a Nitrogen content of 2% calculated on the dry material. Urea and ammonium carbonate have been found the most suitable carriers of Nitrogen on a large scale, as they give a favourable reaction, they are however expensive. Cyanamide and ammonium sulphate may be used but the latter must be supplemented by a base. Hence future work should be directed towards one provision of cheaper sources of nitrogen. In preparing the straw for fermentation it is best to heap it and sprinkle with water and leave for two days, when a further sprinkling may be given. When the interior is uniformly moist the nitrogen may be applied in solution, or broadcasted and watered in. The resultant manure is a well disintegrated plastic material which closely resembles well rotted farmyard manure, and has so far given excellent results during trials.

At the same time, although it is possible in this way to make manure without the intervention of animals, the process can be made to utilise liquid manure as the source of nitrogen by allowing this to run through the straw under conditions which encourage the absorption of nitrogen compounds.

To turn from this to the many bacteriological problems connected with the soil itself, it is at once obvious that an immense field for work exists.

It is well known of course that the soil is inhabited by a great variety of micro-organisms, but we know very little about them either individually or in their relationship to growing plants, although soil fertility is greatly affected by their activities.

The usual methods of investigations are extremely artificial. The organism is picked out and studied on arbitrary media—that is to say it is brought under unnatural conditions the moment it is removed from its ordinary environment. The method has undoubtedly given useful results, but it is naturally open to defects. For one thing micro-organisms are considerably influenced by the medium in which they happen to find themselves, and may react totally differently according to the conditions in which they are placed. In fact this method, which may be termed direct method, has proved very difficult, and has given good results only in the hands of a few workers such as Winogradski, Beijerinck and others.

The more useful methods in use are indirect, and may be classified as follows :—

1. Use of various culture media arranged to bring out different groups of organisms. These are usually arranged to favour nitrification, ammonia production, nitrogen fixation and denitrification.

Here again the fundamental objection to the method is that the reactions are studied in medium very different from ordinary soil.

2. Counts of bacteria are made from soil suspensions suitably diluted on solid culture medium. This method is also faulty, because firstly no

medium is known which will bring out all the soil organisms, so that the results are always low, and no medium even distantly resembles the soil in composition or structure, so that the flora obtained on the plates does not necessarily reflect the flora active in the soil.

3. Chemical determinations of the rate of progress of the various changes going on in the soil—absorption of oxygen, evolution of carbon dioxide, production of nitrate, etc.

If the second and third methods are used in conjunction useful results may be obtained. For example, increase in bacterial numbers are so often associated with increased production of nitrate that one is justified in making the assumption that the phenomena are connected. This is not always the case, however, for example, when ammonia producing organisms are caused to multiply by partial sterilisation of soil they do not increase the stock of ammonia and nitrates beyond a certain limiting amount. On the other hand bacterial activity may show no sort of relationship with soil fertility because there is some other limiting factor other than nitrogen supply or rate of decomposition of plant residues.

4. Bacterial activity may on the surface appear to be directly related to soil fertility, but the relationship is accidental, both bacteria and plants being limited by the same factor, e.g., by acid rain water in districts where there are chemical works.

The above outline indicates very briefly some of the principle methods by which soil bacteriological problems are attacked. Soil conditions have naturally a considerable effect on bacterial numbers and on flora generally and in this country, with its vast extremes of climate, interesting results are certain to be obtained as soon as data have been collected.

Bacteria being living organisms, it is natural to suppose that their activity increases with the temperature up to a certain point. The amount of nitrate produced does show this increase, but bacterial numbers do not.

Increasing moisture supply also causes an increase in bacterial numbers, but this is not regular, and the rate of nitrate production rises to a maximum and then falls, consequent on the lack of air caused by the saturation of the soil. Excess of water will of course also wash out the resulting nitrate from the soil.

The effect of added organic matter is to increase the supplies of energy and therefore to increase bacterial numbers, although whether nitrate supplies will be increased depends on the proportion of nitrogen present in the added matter.

The effects of lime, calcium carbonate and magnesium carbonate have been studied, and the results are somewhat contradictory. Where the work has been done on acid soils, benefit has naturally been derived from neutralisation. In neutral soils less concordant results have been obtained, some observers having observed detrimental effects from further addition of calcium carbonate while others have obtained beneficial results—bacterial number, ammonifying power and nitrifying power all being increased.

Magnesium carbonate may be more effective than calcium carbonate in small quantities but it is toxic in larger amounts. Lime in excess of a certain amount acts as a sterilising agent.

## ENEMIES OF BACTERIA IN THE SOIL.

I should like now to refer to a remark I made earlier, about partial sterilisation of soils resulting in the increased production of ammonia producing organisms.

On the surface this would appear the direct opposite of what one should except. As a matter of fact the apparent contradiction is resolved when one realises that the soil population does not by any means consist mainly of bacteria.

It was found that antiseptics in general first of all diminished the bacteria population, and then led to an enormous increase in numbers, and heat was shown to have the same effect.

Various chemical and physical explanations have been put forward to explain this, but do not wholly account for the facts.

RUSSEL and HUTCHINSON consider that the soil population is complex, and that some of its numbers act detrimentally on the bacteria, which produce plant nutrients. These detrimental forms are more readily killed than the useful bacteria, with the result that the new population produces more ammonia and nitrate than the old one.

This view is still under dispute, as some investigations do not admit the presence of any biological factor in soils detrimental to bacteria.

I have gone into the question of soil bacteriology in some detail, in order to point out that almost the whole of the results so far have been obtained in temperate climates, thereby indicating how much is to be worked out in the tropics.

Another aspect of Agricultural Bacteriology is that of plant disease.

It is now becoming more and more generally realised that bacterial diseases of plants are as common as any other kind.

This branch of agricultural bacteriology is a very young one, the first mention of a bacterial disease being that of pear blight, about forty years ago. Since that announcement the subject has increased enormously, and it is now generally realised that the distribution of bacterial diseases of plants is universal. This is again a subject which has not received a great deal of attention in the tropics, and so, again, a large field for research awaits the attention of the investigator.

The commonest method of infection is probably through wounds in the plant either above or below ground. This indicates the care that should be taken in pruning, and also shows the part which insects may play in the dissemination of disease.

At the same time it is possible for bacteria to infect plants through their natural openings, such as nectaries, water pores and stomata.

Blossom blight of the pear is an example of the first, black rot of the cabbage of the second and angular leaf spot of cotton is mainly stomatal.

Plant diseases have many features in common with those of animals. There is usually latent period, or a period of incubation, during which the disease establishes itself in the plants before it is serious enough to be recognised as such by the damage it does. Like an animal disease it may be thrown off without doing much damage, if the plant is under more favourable condition than the parasite. Everything depends on whether the parasite

finds the initial conditions entirely suited to its needs or can by means of its metabolic processes quickly make them so, and thereby make rapid growth.

To illustrate the variation in the appearance of disease from time of infection, one can cite the various soft rots which usually appear in one or two days after inoculation, and COBB'S disease of suger-cane and STEWART'S disease of sweet corn, which may take one to two months. Of course as with animals, the greater the initial infection the shorter the time in which the plant succumbs.

I have already stated that diseases may be transmitted by insects—they can also be carried on the seed and thereby continue from one crop to the next, or they may be carried in the soil itself. Wind and water may also carry infection and possibly birds ; the case against the insects, molluscs and worms is complete.

I have no time to consider the prevalence and distribution of bacteria plant diseases, but I should just like to touch on the methods of control. I may say at once, in most cases these still remain to be worked out.

Where diseases are transmitted by seeds, bulbs or tubers and cuttings, the obvious remedy is to use these from disease-free stock.

Some seeds will stand treatment in various antiseptics, but care has to be taken in the use of these, as germination may be injured. Germicidal sprays and control of insects by sprays will keep certain diseases in check, and disease resistant varieties should be grown wherever possible.—PLANTERS' CHRONICLE, VOL. XVI, NO. 52.

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# CULTIVATION AND WATER CONTENT OF SOILS.

C. R. HARLER, B.Sc., A.I.C.

It is generally recognised that the chief physical properties of a soil affecting plant growth are moisture, aeration, temperature, texture and tilth. The moisture content is affected by drainage in the rainy season and by keeping a loose surface free from weeds in the dry season. Since the free air space in a soil is that space not occupied by water it follows that aeration is dependent on moisture control. The factor most under control is tilth.

*Tilth.*—After land has been beaten down by rain its volume weight is increased from the well tilled condition brought about through cultivation. The difference is strikingly seen when the height of an area which has been hoed or ploughed is compared with that of the landside. This loose condition is called tilth and results from the formation of complex crumbs between which there are large air spaces. In nature tillage is kept by means of a network of roots and the upper surface of the soil is protected from beating rain by a layer of fallen leaves.

In order to understand the true meaning of tilth it is necessary to consider the ultimate mechanical constitution of the soil. The sand silt and clay particles if they were all separate would form with many soils, especially the heavier ones, a solid mass with practically no free air space. Soils which

have been incorrectly manured and cultivated get into this state and it is often a matter of great time and expense before the soil particles can be aggregated sufficiently to form the "crumb" by which good tilth can be recognised.

*The Optimum Water Content.*—Experienced agriculturists can tell when the soil is in the optimum for cultivation. The soil at the optimum water content contains just enough moisture to cover all the particles and aggregates so that they float in a film of water which acts as a lubricant. At this stage the penetration of the soil is most easy both for plant roots and for agricultural implements. As the soil becomes drier, the film of moisture on the particles becomes thinner and in place of cohesion we get a certain amount of cementation taking place. Finally when the soil is quite dry we get a hard mass which gives rise to solid clods when cultivated.

At the optimum water content the soil occupies its greatest volume and as more water is added it shrinks and in doing so offers a greater resistance to penetration.

*Cultivation and Water Content of the Soil.*—At the end of the rains when the top of the soil has been beaten into a hard cake it is usual to put in a deep hoe and to leave a mulch. This loose layer of soil cuts off the real soil moisture from the air and so effectively stops evaporation that even after a long drought the soil underneath is quite moist. Observations at Tocklai have shown that by this method the moisture remains at about the optimum throughout the dry season, for ordinary drainage is apparently only capable of removing water in excess of the optimum.

If cultivation is carried on whilst the soil is wetter than the optimum the aggregates are broken down in a manner similar to that employed in brick making or in puddling the bottom of tank. If this goes on for some time tilth is destroyed and the crop suffers. After some years, the finer particles which have been released from their aggregates are washed down to the water table and an impermeable pan forms which keeps the water from flowing away in the rains and prevents water from rising in the dry season,

Cultivation at the optimum water content does not involve these complications.

*Determination of the optimum.*—The question may now be asked—How can the optimum be determined? At Tocklai, the soil has often turned beautifully under the hoe but analysis has shown the state to be far above the optimum and undoubtedly tilth has been destroyed. A simple field method has been devised whereby the optimum may be determined.

*Method.*—Take a piled-up double handful of soil (1½-2 lb.) and place in a bottle of about 5 in. diam. and 6½ in. depth. A wide-mouthed stoppered bottle which may be purchased in the bazaar is convenient for this purpose.

A fair average sample from just below the mulch to a depth of six inches should be shaken with a rotary motion in the bottle for about 45 seconds or a minute.

In collecting the sample care should be taken not to allow any dry lumps of soil which occur in the mulch to be mixed with the true, moist soil, otherwise these lumps are liable, in the shaking, to become coated with a layer of moist soil and to resemble puddled globules.

The result of this shaking is to form the soil into balls varying in size according to the water content. When a soil is very wet the whole mass of soil can be shaken into one ball. When the soil is far above the optimum the sides of the bottle become smeared with a sticky mass which is quite distinct from the friable soil which in a drier state sticks to the bottles. Soil at the optimum also forms into balls if it is shaken long enough, but these aggregates have not the sticky, wet look nor the putty-like feel and adhesiveness which occurs with wetter samples.

After a few experiments on the lines described above the optimum condition can be recognised by working the soil on the palm of the hand.

*Good Cultivation.*—Good cultivation does not necessarily mean much cultivation. At Tocklai the soil is analysed every day, the moisture content and the optimum value of the soil has been determined by accurate methods. During April of this year (1921) when 14 inches of rain fell on 22 days, the soil was never in a fit state for cultivation. In May on six days only could cultivation be carried on. The whole of June was wet and thence onwards the optimum state was only occasionally reached during the rains. At times grass and weeds became so thick that a hoe had to be put in but the gain was doubtful. A better process is to fork round the bushes.

The history of cultivation in the tea gardens of North-East India throws an interesting light on some of the present day problems of the tea planter. With the great influx of coolies about 15 years ago a great increase in the number of rounds of hoeing followed. This in turn pushed up the crop, but some years later the effect of loss of tilth and pan formation became apparent in the susceptibility of the bush to blight attack. Gardens which have always been short of labour and which in the rainy season have been forced to put every cooly on to plucking and to obtain cultivation till the cold season have remained comparatively free from blight.—QUARTERLY JOURNAL OF SCIENTIFIC DEPT. OF INDIAN TEA ASSOCIATION, Part III, 1921.

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# MANURES FOR COFFEE PLANTATIONS.

There appears to be no information available as to the effect over a sufficiently long period, of the application of chemical manures on Coffee, to admit of a favourable opinion or a recommendation for general use being given. Such active artificial manures as Sulphate of Ammonia, Sulphate of Potash, Nitrate of Soda, Superphosphate, etc., are undoubtedly of value for annual crops, where immediate results are desirable and the temporary character of the manure is of secondary consideration; but for Coffee—or any other perennial plant—where a slower and more lasting effect is desirable—a similar value has not been established. It has in fact been stated that "most decidedly the active artificial manures would not be suitable for the coffee tree" (SIR JOHN LEWES, "Manures and Coffee," in BULL. BOT. DEPT. JAMAICA March 1897, p. 57) and much difference of opinion seems to prevail in all coffee growing countries on this point.

The manures, however, that may be safely recommended, are those of an organic character, including prunings, leaves, weeds, coffee-pulp and other refuse obtained in the process of preparation of the bean, farm-yard manure, green-manures, bone, dried blood, oil-seed cake, guano, fish. manure, to which may be added the inorganic substances, wood-ashes and lime.

Farm manures and green manures, may not be practicable on all plantations ; but in respect of the first, the suggestion of rotting down straw to take its place may be worthy of consideration—this is effected by a process recently discovered as the result of many years' investigation. Humification of the straw is brought about by a fermenting organism ; but wet straw alone will not rot down, and some active form of nitrogen to start the process is required—this may be supplied by the urine from stock or by passing sewage through a filter bed made up of straw. At Wainfleet (Lincolnshire) this method has been applied to deal with the sewage from a camp of some 200 men, and further trials are in progress to work out a method of making farmyard manure on a large scale without animals (see "The Present Position of Research in Agriculture," by SIR. DANIEL HALL, in Journal of the Royal Society of Arts, April 1st, 1921, p. 305).

The selection, however, of any of the manures mentioned can only be decided on a knowledge of local conditions and under experiment, especially as regards convenience and cost.

A manure of considerable value may be made by mixing the pulp with bone-meal (in the proportion of about one part bone-meal and twenty parts coffee-pulp) together with any general refuse from the plantation, heaped or buried under protection from sun and rain for several months—after the usual method of preparing manure heaps. When sufficiently decayed it may be dug in round the trees, without injury, to the roots if possible, or laid on as a mulch.

The pulp together with parchment and other refuse from the factory, is of value because of the Nitrogen, Phosphoric acid, Potash and Lime it contains and the Bone-meal for the Phosphoric acid, Lime and Nitrogen contained in it. The percentages of the constituents mentioned in the coffee-pulp are considerably higher in fresh material than after exposure to sun and rain for several months, and it is important to conserve them as above described. Any wood-ashes that may be available from burning rubbish on the plantation might be put into the manure heap, to increase the supply of potash. Slaked lime when this is found necessary, (and tropical soils are very often deficient in this respect), might be applied with advantage by distributing it over the whole plantation a few months before applying the mixed or other manures, at the rate of about 15 cwt. per acre or with trees 9 ft. by 9 ft. this would be approximately 3 lb. per tree.

Some guide to the requirements of the coffee trees may be found in the following table, from "Le Cafe": Dans L'Etat de Saint Paul (Brésil)", by A. LALIERE (Paris, 1909) p. 122 :—

The annual requirements of 1,000 coffee plants at different ages, of nitrogen, potash and phosphoric acid—the most important constituents taken up by them from the soil, are :—

| Age of Tree | Nitrogen | Potash | Phosphoric Acid |
|---|---|---|---|
| | lb. | lb. | lb. |
| First 4 years - - | 9·87 | 23·62 | 2·49 |
| From 5 to 8 years : - | 35·7 | 76·92 | 19·57 |
| From 9 to 20 years - - | 28·87 | 45·83 | 15·76 |
| After 20 years (old trees) - | 5·09 | 30·53 | 9·48 |

KEW BULLETIN No. 9, 1921.

# PESTS AND DISEASES.

## THE PRESENT PREVALENCE OF SHOT-HOLE BORER OF TEA.

F. P. JEPSON, M.A., F.E.S.

*Assistant Entomologist, Department of Agriculture, Ceylon.*

At a recent meeting of the Estates Products Committee of the Board of Agriculture the opinion was expressed that Shot-hole borer was on the increase and was certainly spreading to higher elevations. In order that a general expression of opinion might be obtained it was suggested by the Committee that all borer-infested estates should be circularised with a request for information on this point. Accordingly circular letter-cards were despatched to all infested estates early in November 1921, and in order that as many replies as possible should be obtained, particular care was taken to reduce the trouble given to those addressed to a minimum. It was only necessary for the recipient of a letter card to detach the perforated reply portion, write "yes" or "no" to each question, sign his name with the name of the estate and post, the reply card being addressed to the Assistant Entomologist and franked for free postage. It was anticipated that at least 80% of replies would have been received, but of the 821 circulars sent out only 603 cards were returned, being equivalent 73·5%. The conclusions arrived at in this paper are based therefore upon the opinions of seventy three per cent of the estates circularised and must be accepted as being representative of the infested districts.

The statement that shot-hole borer was on the "increase" has two interpretations. It is possible, on the one hand, that borer might be on the increase in the sense that it was more prevalent, or intense, in fields where it had been established for many years, while it might, on the other hand be considered on the increase from the point of view of extending its range of attack to portions of an estate which had not previously been infested. For this reason two questions were asked differentiating between these two interpretations of the word "increase." A third question was included inviting the opinion of the Superintendent as to whether borer was spreading in the district in which his estate was situated.

The questions asked were as follows :—

1. In fields where Shot-hole Borer has been established for some years, do you consider that borer is more prevalent at the present time than formerly, say, five years ago ?
2. Is borer at present invading portions of your estate which have hitherto remained free ?

3. Do you consider that borer is on the increase in your district?

The replies received have been carefully examined being dealt with in turn according to question and finally summarised. In the case of three districts one circular only was sent to each, two circulars to one district, four circulars to two districts and five circulars to three districts. As the majority of opinions in these cases, expressed as a percentage or ratio for each district would be somewhat misleading, percentages or ratios have not been adopted to indicate a majority opinion for each district. The opinions in favour of or against, borer increase are given in the following tables with the majority of opinions in the final column. The relationship of the majority of opinions expressed to the number of circulars sent out and returned may be seen at a glance from the tables. It is interesting to record that thirty-three replies received emphasised the fact that Shot-hole borer was not more prevalent and was not spreading either on estates or in districts owing to improved cultivation. In forty-one cases where borer was stated to be more prevalent and spreading, the opinion was expressed that this was owing to the cultivation programme having been curtailed on the estates in question. In one case borer was regarded as not being more prevalent where prunings were burnt immediately after pruning, in another where wood was not heavily cut down at pruning time and in still another where green manure was generously applied. In one instance borer was said to be less in fields which had never received any manure, and in another instance it was remarked that there had been a marked decrease in borer during 1921 in spite of reduced cultivation. This information was not asked for and was volunteered, and it would have greatly added to the value of the information desired from this circular if opinions had been invited as to the reason for an increase or decrease in Shot-hole borer incidence at the present time.

## THE PREVALENCE OF BORER ON ESTATES.

The first question asked was in regard to the present prevalence of, or intensity of attack by, Shot-hole borer upon estates. There has been, for some time past, a most decided opinion, on the part of planters in many of the infested areas, that borer was on the decline and by no means so serious a pest as in the past. This has also been the official view especially during the past eighteen months, but it has not been possible to account for this reduced attack. It was considered that borer might have been influenced by the improved cultivation which, in many cases, followed the conclusion of the war period during which many manures were unobtainable, but no information is available in support of this opinion.

The replies received in answer to the first question are therefore of considerable interest and support in a most marked manner the statements which have been repeatedly made. They have been classified in the

following table :—

**TABLE I.**

**Prevalence of Shot-hole borer on Estates.**

| Planting District | Total number of circulars | | Total opinions expressed | | Majority of opinions expressed | |
|---|---|---|---|---|---|---|
| | Sent out | Returned | Borer more prevalent | Borer not more prevalent | Borer more prevalent | Borer not more prevalent |
| Alagalla | 22 | 18 | 3 | 14 | — | 11 |
| Ambagamuwa | 31 | 17 | 6 | 9 | — | 3 |
| Badulla | 62 | 52 | 19 | 29 | — | 10 |
| Balangoda | 17 | 10 | 3 | 3 | — | — |
| Dikoya | 4 | 2 | — | 2 | — | 2 |
| Dikoya Lower | 22 | 16 | 3 | 13 | — | 10 |
| Dimbula | 9 | 8 | 1 | 4 | — | 3 |
| Dolosbage | 53 | 30 | 4 | 17 | — | 13 |
| Dumbara | 5 | 2 | — | 2 | — | 2 |
| Galagedera | 10 | 5 | 2 | 3 | — | 1 |
| Galle | 4 | 2 | 1 | 1 | — | — |
| Hantane | 24 | 18 | 7 | 11 | — | 4 |
| Haputale | 43 | 38 | 18 | 18 | — | — |
| Haputale West | 1 | 1 | — | 1 | — | 1 |
| Hewaheta Lower | 22 | 20 | 6 | 8 | — | 2 |
| Hewaheta Upper | 11 | 4 | 1 | 3 | — | 2 |
| Hunasgeriya | 13 | 13 | 2 | 10 | — | 8 |
| Kadugannawa | 21 | 16 | 4 | 11 | — | 7 |
| Kalutara | 8 | 7 | — | 6 | — | 6 |
| Kegalle | 12 | 8 | 2 | 5 | — | 3 |
| Kelani Valley | 37 | 26 | 7 | 18 | — | 11 |
| Kelebokke | 16 | 14 | 2 | 9 | — | 7 |
| Knuckles | 22 | 15 | 8 | 5 | 3 | — |
| Kotmale | 23 | 15 | 8 | 5 | 3 | — |
| Madulsima | 15 | 13 | 4 | 9 | — | 5 |
| Maskeliya | 8 | 5 | — | 4 | — | 4 |
| Matale East | 41 | 33 | 7 | 26 | — | 19 |
| Matale North | 7 | 2 | 1 | 1 | — | — |
| Matale South | 18 | 13 | 6 | 7 | — | 1 |
| Matale West | 15 | 8 | 1 | 7 | — | 6 |
| Maturata | 10 | 9 | 1 | 8 | — | 7 |
| Medamahanuwara | 12 | 10 | 6 | 3 | 3 | — |
| Morawak Korale | 1 | 1 | — | — | — | — |
| New Galway | 5 | 5 | 2 | 2 | — | — |
| Nilambe | 27 | 22 | 4 | 15 | — | 11 |
| Nitre Cave | 1 | 1 | 1 | — | 1 | — |
| Passara | 21 | 17 | 9 | 8 | 1 | — |
| Pundaluoya | 7 | 7 | 1 | 6 | — | 5 |
| Pussellawa | 63 | 43 | 13 | 26 | — | 13 |
| Rakwana | 5 | 5 | 3 | 2 | 1 | — |
| Rangala | 14 | 11 | 6 | 5 | 1 | — |
| Ratnapura | 22 | 15 | 5 | 6 | — | 1 |
| Uda Pussellawa | 10 | 8 | 4 | 3 | 1 | — |
| Walapane Lower | 2 | 2 | — | 2 | — | 2 |
| Wattegama & Panwila | 17 | 11 | 4 | 5 | — | 1 |
| Yakdessa | 7 | 5 | — | 5 | — | 5 |
| Total for all districts | 820 | 603 | 185 | 357 | 14 | 186 |
| Do. expressed as % | 100·0 % | 73·5 % | 34·1 % | 65·9 % | — | 31·8 % |

*Note.*—Where the total number of opinions expressed is less than the number of circulars returned, the difference represents returns where no opinion could be expressed.

As will be seen from the above table 821 circulars were sent out and 603 returned being equal to 73·5%. Borer is considered to be more prevalent in eight districts, viz., Knuckles, Kotmale, Madulsima, Nitre Cave, Passara, Rakwana, Rangala and Udapussellawa. Of these districts one opinion only was received from Nitre Cave, while Passara, Rakwana, Rangala and Udapussellawa have decided in favour of borer being more prevalent by a majority of one opinion only in each district, Knuckles and Kotmale and Medamahanuwara by three opinions each, opinions are equally divided in the case of Balangoda, Galle, Haputale, Matale North and New Galway and no opinion is expressed in the case of Morawak Korale.

The remaining thirty-two districts unanimously consider borer not to be more prevalent. The total opinions for all districts in favour of borer being more prevalent number 185 (34·1%) against 357 (65·9%) to the contrary, or a majority against of 172, equivalent to 31·8%. It should be mentioned that although borer is considered by some to be more prevalent on estates in Badulla, Haputale and Ratnapura, the replies received do not support this view.

It may be assumed therefore in regard to this question that the general opinion is decidedly against borer being more prevalent on estates.

**THE EXTENSION OF THE AREA ATTACKED ON ESTATES.**

The second question was asked with the object of ascertaining whether borer was on the increase in the sense that it was spreading upon estates and invading portions of estates hitherto uninfested. It was anticipated that replies in answer to this question would decide whether borer was extending to higher elevations. Some estates have been completely infested for many years and no possible extension is possible, but there are many, especially up-country, where borer has been restricted to the lower elevations. The following table summarises the replies received in answer to this question.

Borer is considered to be extending its area of attack upon estates in ten districts, viz: Haputale, Knuckles, Madulsima, Medamahanuwara, New Galway, Nitre Cave, Rakwana, Ratnapura, Udapussellawa and Wattegama and Panwila. Nitre Cave is represented by one opinion only. Haputale favours the spread of borer on estates by a majority of fifteen opinions, Medamahanuwara by eight, Ratnapura and Wattegama and Panwila by four each, Madulsima by three and New Galway, Rakwana and Udapussellawa by one opinion each. Opinions on this question are divided in Dumbara, Galle, Matale North and Walapane Lower, while the remaining thirty-two districts are unanimously of the opinion that borer is not extending its range on estates. The total opinions for all districts in favour of borer spreading on estates number 190 (33·2%) and 382 (66·8%) the contrary, or a majority against of 192 opinions equal to 33·6%.

It is concluded therefore that borer is extending its range of attack on estates in the Haputale and Medamahanuwara districts where the spread is marked, and Knuckles, Madulsima, Ratnapura and Wattegama and Panwila

where the spread is less marked.

**TABLE II.**

**Extension of area attacked on estates.**

| Planting District | Total number of circulars | | Total opinions expressed | | Majority of opinions expressed | |
|---|---|---|---|---|---|---|
| | Sent out | Returned | Borer spreading on estates | Borer not spreading on estates | Borer spreading on estates | Borer not spreading on estates |
| Alagalla | 22 | 18 | 3 | 13 | — | 10 |
| Ambagamuwa | 31 | 17 | 2 | 13 | — | 11 |
| Badulla | 62 | 52 | 24 | 28 | — | 4 |
| Balangoda | 17 | 10 | 3 | 7 | — | 4 |
| Dikoya | 4 | 2 | — | 2 | — | 2 |
| Dikoya Lower | 22 | 16 | 4 | 12 | — | 8 |
| Dimbula | 9 | 8 | 2 | 6 | — | 4 |
| Dolosbage | 52 | 30 | 1 | 23 | — | 22 |
| Dumbara | 5 | 2 | 1 | 1 | — | — |
| Galagedera | 10 | 5 | 1 | 2 | — | 1 |
| Galle | 4 | 2 | 1 | 1 | — | — |
| Hantane | 24 | 18 | 4 | 14 | — | 10 |
| Haputale | 43 | 38 | 26 | 11 | 15 | — |
| Haputale West | 1 | 1 | — | — | — | 1 |
| Hewaheta Lower | 22 | 20 | 9 | 10 | — | 1 |
| Hewaheta Upper | 11 | 4 | — | 4 | — | 4 |
| Hunasgeriya | 13 | 13 | 2 | 11 | — | 9 |
| Kadugannawa | 21 | 16 | 5 | 10 | — | 5 |
| Kalutara | 8 | 7 | 1 | 5 | — | 4 |
| Kegalle | 12 | 8 | 2 | 5 | — | 3 |
| Kelani Valley | 37 | 26 | 4 | 19 | — | 15 |
| Kelbokke | 16 | 14 | 4 | 7 | — | 3 |
| Knuckles | 22 | 15 | 8 | 4 | 4 | — |
| Kotmale | 23 | 15 | 5 | 10 | — | 5 |
| Madulsima | 15 | 13 | 8 | 5 | 3 | — |
| Maskeliya | 8 | 5 | — | 5 | — | 5 |
| Matale East | 41 | 33 | 6 | 27 | — | 21 |
| Matale North | 7 | 2 | 1 | 1 | — | — |
| Matale South | 18 | 13 | 6 | 7 | — | 1 |
| Matale West | 15 | 8 | 1 | 7 | — | 6 |
| Maturata | 10 | 9 | 4 | 5 | — | 1 |
| Medamahanuwara | 12 | 10 | 9 | 1 | 8 | — |
| Morawak Korale | 1 | 1 | — | 1 | — | 1 |
| New Galway | 5 | 5 | 3 | 2 | 1 | — |
| Nilambe | 27 | 22 | 3 | 19 | — | 16 |
| Nitre Cave | 1 | 1 | 1 | — | 1 | — |
| Passara | 21 | 17 | 4 | 11 | — | 7 |
| Pundaluoya | 7 | 7 | 1 | 6 | — | 5 |
| Pussellawa | 63 | 43 | 3 | 40 | — | 37 |
| Rakwana | 5 | 5 | 3 | 2 | 1 | — |
| Rangala | 14 | 11 | 4 | 7 | — | 3 |
| Ratnapura | 22 | 15 | 9 | 5 | 4 | — |
| Uda Pussellawa | 10 | 8 | 4 | 3 | 1 | — |
| Walapane Lower | 2 | 2 | 1 | 1 | — | — |
| Wattegama & Panwila | 17 | 11 | 7 | 3 | 4 | — |
| Yakdessa | 7 | 5 | — | 5 | — | 5 |
| Totals for all districts | 820 | 603 | 190 | 382 | 42 | 234 |
| Do expressed as % | 100·0 % | 73·5 % | 33·2 % | 66·8 % | — | 33·6 % |

*Note.*—Where the total number of opinions is less than the number of circulars returned, the difference represents returns where no opinion could be expressed.

## THE SPREAD OF SHOT-HOLE BORER IN DISTRICTS.

The views of districts in regard to this question are summarised in the following table :—

**TABLE III.**
**Spread of borer in Districts.**

| Planting District | Total number of circulars | | Total opinions expressed | | Majority of opinions expressed | |
|---|---|---|---|---|---|---|
| | Sent out | Returned | Borer spreading in districts | Borer not spreading in districts | Borer spreading in districts | Borer not spreading in districts |
| Alagalla | 22 | 18 | 1 | 11 | — | 10 |
| Ambagamuwa | 31 | 17 | 1 | 9 | — | 8 |
| Badulla | 62 | 52 | 29 | 15 | 14 | — |
| Balangoda | 17 | 10 | 3 | 7 | — | 4 |
| Dikoya | 4 | 2 | — | 2 | — | 2 |
| Dikoya Lower | 22 | 16 | 2 | 13 | — | 11 |
| Dimbula | 9 | 8 | — | 4 | — | 4 |
| Dolosbage | 52 | 30 | 6 | 16 | — | 10 |
| Dumbara | 5 | 2 | — | 2 | — | 2 |
| Galagedera | 10 | 5 | 2 | 2 | — | — |
| Galle | 4 | 2 | 1 | — | 1 | — |
| Hantane | 24 | 18 | 6 | 11 | — | 5 |
| Haputale | 42 | 38 | 20 | 6 | 14 | — |
| Haputale West | 1 | 1 | — | 1 | — | 1 |
| Hewaheta Lower | 22 | 20 | 9 | 10 | — | 1 |
| Hewaheta Upper | 11 | 4 | — | 4 | — | 4 |
| Hunasgeriya | 13 | 13 | 2 | 7 | — | 5 |
| Kadugannawa | 21 | 16 | 3 | 8 | — | 5 |
| Kalutara | 8 | 7 | — | 3 | — | 3 |
| Kegalle | 12 | 8 | 2 | 3 | — | 1 |
| Kelani Valley | 37 | 26 | 9 | 10 | — | 1 |
| Kelebokke | 16 | 14 | 4 | 4 | — | — |
| Knuckles | 22 | 15 | 7 | 4 | 3 | — |
| Kotmale | 23 | 15 | 7 | 3 | 4 | — |
| Madulsima | 15 | 13 | 3 | 5 | — | 2 |
| Maskeliya | 8 | 8 | — | 4 | — | 4 |
| Matale East | 41 | 33 | 8 | 19 | — | 11 |
| Matale North | 7 | 2 | 2 | — | 2 | — |
| Matale South | 18 | 13 | 6 | 7 | — | 1 |
| Matale West | 15 | 8 | 1 | 6 | — | 5 |
| Maturata | 10 | 9 | 3 | 6 | — | 3 |
| Medamahanuwara | 12 | 10 | 10 | — | 10 | — |
| Morawak Korale | 1 | 1 | — | — | — | — |
| New Galway | 5 | 5 | 1 | 2 | — | 1 |
| Nilambe | 27 | 22 | 4 | 16 | — | 12 |
| Nitre Cave | 1 | 1 | 1 | — | 1 | — |
| Passara | 21 | 17 | 7 | 6 | 1 | — |
| Pundaluoya | 7 | 7 | 2 | 4 | — | 2 |
| Pussellawa | 63 | 43 | 14 | 16 | — | 2 |
| Rakwana | 5 | 5 | 3 | 2 | 1 | — |
| Rangala | 14 | 11 | 4 | 6 | — | 2 |
| Ratnapura | 22 | 15 | 8 | 6 | 2 | — |
| Uda Pussellawa | 10 | 8 | 4 | 4 | — | — |
| Walapane Lower | 2 | 2 | — | — | — | — |
| Wattegama & Panwila | 17 | 11 | 9 | 1 | 8 | — |
| Yakdessa | 7 | 5 | — | 5 | — | 5 |
| Total for all districts | 820 | 603 | 204 | 270 | 61 | 127 |
| Do expressed as % | 100·0 % | 73·5 % | 42·0 % | 57·0 % | — | 15·0 % |

*Note.*—Where the total number of opinions is less than the number of circulars returned, the difference represents returns where no opinion could be expressed.

Borer is considered to be spreading in twelve districts, viz: Badulla, Galle, Haputale, Knuckles, Kotmale, Matale North, Medamahanuwara, Nitre Cave, Passara, Rakwana, Ratnapura and Wattegama and Panwila. Of these districts one opinion only is again registered in the case of Nitre Cave, while borer is considered to be spreading in Badulla and Haputale by a majority of fourteen opinions in each case, in Medamahanuwara by ten opinions, Wattegama and Panwila by eight, Kotmale by four, Knuckles by three, Matale North and Ratnapura by two each, and Galle, Passara and Rakwana by one opinion each. Opinions are divided in Galagedera, Kelebokke, Udapussellawa and Walapane Lower, and no opinion is expressed in the case of Morawak Korale. The remaining twenty-nine districts decide against borer spreading in their districts.

The total opinions favouring a spread of borer number 204 (42·0%) and those against 270 (57·0%). The conclusion to be drawn is therefore that borer is undoubtedly extending its sphere of attack in the Badulla, Haputale, Knuckles, Medamahanuwara, and Wattegama and Panwila districts, but as regards other districts reporting a spread of borer, the majority of opinions favouring this view are not striking.

## THE SUMMARY OF OPINIONS OF DISTRICTS.

The opinions of the forty-six districts concerned in regard to the three questions asked are summarised in the following table :—

**TABLE IV.**

**Summary of opinions of all Districts.**

| Opinions expressed | Number of districts | | |
|---|---|---|---|
| | Question 1 | Question 2 | Question 3 |
| Borer more prevalent on estates | 8 | — | — |
| Borer not more prevalent on estates | 32 | — | — |
| Borer spreading on estates | — | 10 | — |
| Borer not spreading on estates | — | 32 | — |
| Borer spreading in district | — | — | 12 |
| Borer not spreading in district | — | — | 29 |
| Opinions even | 5 | 4 | 4 |
| No opinions expressed | 1 | — | 1 |
| Total number of districts | 46 | 46 | 46 |

The voting of districts may, very approximately, be stated to be that they decide against borer being more prevalent on estates by a majority of 4 to 1, against borer spreading on estates by a majority of 3 to 1 and against borer spreading in districts by a majority of 2 to 1.

In regard to the views of those districts which report some increase in borer, the opinions expressed have been classified in the following table. Only 15 districts out of forty-six are concerned, the remaining thirty-one districts deciding, from every point of view that borer is not on the increase.

**TABLE V.**
**Summary of opinions of districts reporting increase of borer.**

| Opinions expressed | District | Number of opinions | | |
|---|---|---|---|---|
| | | For | Against | Majority |
| Borer more prevalent on estates | Rangala | 6 | 5 | 1 |
| Borer spreading on estates | Madulsima | 8 | 5 | 3 |
| | New Galway | 3 | 2 | 1 |
| Borer spreading in district | Badulla | 29 | 15 | 14 |
| | Matale North | 2 | 0 | 2 |
| Borer more prevalent and spreading on estates | Udapussellawa | 8 | 6 | 2 |
| Borer more prevalent on estates and spreading in districts | Kotmale | 15 | 8 | 7 |
| | Passara | 16 | 14 | 2 |
| Borer spreading on estates and also in districts | Haputale | 46 | 17 | 29 |
| | Ratnapura | 17 | 11 | 6 |
| | Wattegama and Panwila | 16 | 4 | 12 |
| Borer more prevalent on estates and spreading both on estates and in districts | Knuckles | 23 | 13 | 10 |
| | Medamahanuwara | 25 | 4 | 21 |
| | Nitre Cave | 3 | 0 | 3 |
| | Rakwana | 9 | 6 | 3 |

The districts which report an all-round increase in borer as regards prevalence on estates, and spread both on estates and in districts are Knuckles, Medamahanuwara, Nitre Cave and Rakwana, by a majority of ten, twenty-one, three and three opinions respectively. The opinions given in the case of Nitre Cave are from a single estate. Borer is undoubtedly spreading in the Badulla district, is more prevalent on estates and spreading in the Kotmale district and is spreading on estates and in the districts of Haputale, Ratnapura and Wattegama.

**CONCLUSIONS.**

(1). Eight districts consider borer to be more prevalent on estates and thirty-two the contrary, opinions being divided in five districts and one district offering no information. Ten districts consider borer to be spreading on estates and thirty-two the contrary, opinions being equal in four districts. Borer is considered to be spreading in ten districts, while this is considered not to be the case in twenty-nine districts, opinions being equal in four districts and the remaining one offering no opinion on the matter.

(2). Judging from the replies received opinions are in favour of borer being more prevalent on estates in Knuckles, Kotmale, and Medamahanuwara, to be extending its area of attack on estates in Haputale, Knuckles, Madulsima, Medamahanuwara, Ratnapura and Wattegama and Panwila and to be spreading in the following districts :— Badulla, Haputale, Knuckles, Kotmale, Medamahanuwara and Wattegama and Panwila. The most emphatic opinions are in the case of Badulla where borer is decidedly spreading in the district, Haputale and Wattegama and Panwila where it is spreading both on estates and in these districts, and Knuckles and Medamahanuwara where it is more prevalent, and spreading on estates and in these two districts.

(3). It is interesting to record that seventy-four opinions were volunteered in regard to the connection between improved cultivation and reduced borer-attack and it is regretted that the scope of the circular was not extended to invite opinions on this matter.

(4). It is concluded therefore that borer is either more prevalent or is extending its activities in the following districts :— Badulla, Haputale, Knuckles, Kotmale, Medamahanuwara, Wattegama and possibly Ratnapura,

# APICULTURE.

## BEE-KEEPING NOTES.

One of the most troublesome experiences in bee-keeping in Ceylon is the fact that the frames made by local carpenters do not exactly correspond. In removing a frame containing sealed honey, and trying to replace it with an empty frame, it is frequently found that the latter does not fit. Such mistakes increase the risks run by the bee-keepers in manipulating hives by worrying the bees unnecessarily. When apiculture becomes more generally adopted, it should be possible to arrange with a recognised firm of joinery to undertake the construction of hives, so as to make all the parts interchangeable.

For quieting down bees, and sending them below, a tobacco pipe or cigar will be found more handy and serviceable than a bellows, which frequently handicaps the bee-keeper. Good whiffs of tobacco smoke skillfully blown across the top of the frames, as a rule scares bees: but some strains, such as the Egyptian, are said to resent the use of tobacco smoke which makes them wild. Bee hunters in Ceylon chew pepper corns and blow into the hives, using a small bamboo tube for the purpose.

The question of providing lateral space for honey storage has been raised by one of the members of the Ceylon Bee-keepers' Association. To carry out this plan, it would be desirable to place two queen-excluder sheets on either side of the space occupied by the brood nest. Elimination of the super, and the lateral extension of the hive is not unknown in England and is recommended by some authorities.

MR. A. P. GOONATILLEKE has proved to satisfaction that the *Apis indica* bee will accept for storage of honey in the super comb-foundation intended for Italian bees. He has turned out some excellent "Sections" of honey, the cells of which were drawn out from such foundation. Other members of the Ceylon Bee-keepers' Association are arranging to use English foundation, kindly provided by MR. GOONATILLEKE, in their super frames.

Bee-keeping is being taken up so keenly that many Government school teachers and their pupils are becoming quite expert in the handling of bees. Two ex-pupils of Ginigathena School are making a business of capturing swarms, and are prepared to supply colonies at Rs. 5 each. In starting bee-keeping, it is best to begin with a colonised hive; and amateur bee-keepers upcountry may be glad to know that they can get stocks of bees from the suppliers referred to above (G. A DISSANAYAKE and K M. GUNERATNE of Ginigathena, Nawalapitiya) who undertake to colonise hives and deliver them to the owners after stocking. Hives, of approved pattern, are available from the Secretary of the Ceylon Bee-keepers' Association, Peradeniya, at Rs. 10 each: "Supers" are Rs. 5 extra.

C. D.

# CO-OPERATION.

## NOTE ON AGRICULTURAL CO-OPERATION IN MYSORE.

There are now nearly 1,500 Co-operative societies in the Mysore State of which nearly 1,360 are credit societies for providing the members with capital. Societies for agricultural or industrial purposes are comparatively few. This is to a large extent natural. The first requirement of a raiyat is credit, and societies for providing it must therefore take priority over other kinds of societies. The Co-operative Department was therefore engaged in meeting this demand. Conditions have changed, however, during the past three or four years. A large number of credit societies have been established in different parts of the State. They have provided their members with capital and trained them in joint action and concerted effort. With their first requirement met to some extent, the members are now turning their thoughts to co-operative societies for the supply of agricultural requirements and for the sale of their produce and the Department is now engaged in meeting this new demand.

Agricultural Co-operation helps the agriculturist in three distinct ways :—

1. It provides him with the capital he needs to carry on his occupation.
2. It puts him in the way of utilising his capital most economically, and
3. It enables him to sell his produce to the best advantage. Co-operative credit societies obviously perform the first of these functions. The second is performed by societies of various types, such as societies for the supply of seed, of implements, of household goods, of machinery, and the like. And the last function is performed by several kinds of productive and sale societies. The bulk of the work that we here in Mysore have done is with respect to the supply of capital. And even there our work is far from complete. Out of a total of 16,000 villages in this State about 5,000 are served by co-operative credit societies, and they are but inadequately served. The first step therefore in our scheme of Agricultural Co-operation is to multiply credit societies and increase their membership and working capital.

Simultaneously with the increase of credit societies, we should proceed with the formation of the supply, productive and sale societies referred to in the previous paragraph. It is difficult to suggest the exact types of societies which are likely to succeed in Mysore. But I have had the benefit of DR. COLEMAN'S advice and he is of opinion that steps may be taken for the formation of societies for the supply of manure and seed. It is also possible

to start societies for the supply of ploughs, threshing machines and some of the other implements recommended by the Agricultural Department. The less costly implements may be sold outright to the member and the more costly ones may remain the property of the societies and hired out to the members. Societies for lift irrigation have a great future in Mysore especially in the dry districts of Tumkur, Kolar and Chitaldrug and in some of our river valleys. Societies for the sale of copra, of arecanut, of cotton and other commercial crops and of betel leaves, vegetables, eggs and the like may also be tried. Societies for the sale of milk, butter and ghee have often been thought of and two or three have been registered, but the difficulties connected with their management render them impracticable for the present.

Coming to agricultural productive societies, we have only two kinds of them, viz., jaggery-making and rice-hulling societies. The jaggery-making societies have so far proved a failure and the rice hulling societies have not yet proved a success. As regards the latter, if only the societies are able to get a sufficient supply of paddy, their success appears to be certain.

As regards other forms of agricultural productive societies, there is scope for starting societies to convert areca into nut, and coconut, ground-nut and oil seeds into oil and cake. But anything done in this line must be preceded by a very careful examination of local conditions and circumstances.

In addition to the items of work enumerated in this note, there are certain special schemes which probably could be usefully undertaken on co-operative lines, *e.g.*, the development of the area irrigated by the Tungabhadra, and the extension of sugar-cane cultivation in the area irrigated by the Krishnara jasagara Reservoir.

With so many possibilities, it might appear strange that so little has actually been accomplished in the line of agricultural co-operation. But there are several difficulties. The first is that those who are responsible for the development of co-operation are naturally averse to anything in the nature of an experiment which might or might not turn out a success. But the possibility of failure has to be faced and every precaution which common sense or experience suggests should be taken against such failure. Secondly, non-official leaders are few in Mysore. Everything has practically got to be done by an official agency. An improvement in this respect can come only in course of time and in the meanwhile one can but try as best as one can to interest the people in one's schemes. Lastly, the ignorance of the people offers a difficulty which is practically insurmountable. Arguments, evidence of facts and figures, instances of successes elsewhere, these are absolutely unheeded. But there is a perceptible change for the better in this direction and with the spread of education there is no doubt this difficulty will gradually disappear.—MYSORE AGRIC. CALENDAR, 1922.

# GENERAL.

## BANANA FIBRE.

G. P. DARNELL-SMITH, D.Sc., F.I.C., F.C.S., *Biologist.*

Some interest has been aroused recently in the banana-growing districts of the Tweed in the possibility of banana fibre having a commercial use. After a stool has thrown its bunch and the bunch has been cut, there remains the stem, and it is thought that if the fibre in this could be economically obtained it might be an additional source of income.

The prospects of making use of banana-fibre, however, do not appear to be very bright. W. FAWCETT, in his book on THE BANANA, states (p. 151) :—

The question of the value of fibre from the stem of the banana comes up again and again for discussion in the West Indies, although it was practically settled many years ago, when SIR. D. MORRIS was Director of Public Gardens and Plantations, Jamaica. The stem yields less than 1½ per cent. of its weight, that is, about 1½ lb. per ordinary stem as cut. This fibre is described by experts as being "very weak, poor colour, and woody," and as being "only fit for paper worth about £7 or £8 per ton." To obtain 1 ton of fibre it would therefore be necessary to handle nearly 100 tons of fresh stems which must be dealt with as soon as cut and on the spot. This, no doubt could be managed if it were worth while, but as the local prices would probably not exceed 1*d.* per lb., it is scarcely likely that any serious attempt will be made to extract it.

These views were expressed in 1905 by SIR. D. MORRIS, and since then the values of even poor fibres may have increased considerably. The fact, however, must not be lost sight of that to obtain one ton of banana fibre, it would be necessary to handle 100 tons of fresh stems, while on the other hand, the chopped stem has considerable value as manure. It may possibly be that the fibre of the Cavendish banana grown on the Tweed has more value than the Gros Michel grown in Jamaica, for this fibre, when well prepared, appears to have a breaking strain not much inferior to New Zealand flax, and to have greater elasticity.

Two samples were recently submitted for examination to the Technological Museum, and the Curator (Mr. G. HOOPER) has furnished a report, from which the following is extracted :—

"The banana fibres forwarded by you have been tested by the Economic Botanist, in comparison with several commercial fibres, with the following

results, the breaking strain being given in kilograms per square millimetre:—

| | Extension | Breaking strain in kilograms per sq. millimetre | |
|---|---|---|---|
| | Per cent. | | |
| Manilla Hemp - - | 2·52 | 72·61 | |
| New Guinea Sisal - | 2·63 | 56·09 | |
| Java Sisal - - | 2·66 | 55·07 | |
| New Zealand Flax - | 1·99 | 48·41 | These figures are the mean of those obtained from a number of tests. |
| Banana fibre (No. 1) - | 5·13 | 43·18 | |
| ,, ,, (No. 2) - | 1·95 | 37·19 | |

"Banana fibre (No. 1).—The extension is remarkably high, and the fibre is particularly even in area in cross section. The fibre is very clean, and free from adhering thin-walled cellular material.

Banana fibre (No. 2.).—This fibre is much inferior in general appearance to No. 1. A large amount of loose adhering cellular matter is present, and a number of the fibres gave a very low breaking strain, though some individual fibres gave very good results. The extension also is much lower, the fibres being in many cases more brittle.

It will be seen from the figures that sample No. 1 is not very much inferior to New Zealand flax, and it possesses a much greater elasticity."

—AGRIC. GAZ. N.S.W., VOL. XXXII, PART 12.

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# POWER ALCOHOL.

## UTILIZATION OF EXHAUSTED MOLASSES.

Those interested in the production of power alcohol in tropical countries from the exhausted molasses of sugar-cane factories should secure a copy of Bulletin No. 21 of the Department of Agriculture, Mauritius, entitled "The Composition and Utilisation of Exhausted Molasses in Mauritius" by TEMPANY AND D'AVOINE.

It is estimated that in Mauritius sugar-cane molasses to the extent of 9,000,000 to 10,000,000 gallons are produced annually and that not more than 1,000,000 gallons are utilized every year for the production of potable spirits. The remainder of the molasses is either fed to stock, burnt in the furnaces of sugar factories or applied to the land as a fertilizer.

The value of molasses as a fertilizer to the sugar-cane soils of Mauritius has been established by exhaustive experiments and any proposal to utilize molasses for the production of power alcohol in that colony has to give careful consideration to this agricultural aspect of the question.

Investigations were therefore made in 1915-17 to test whether the fertilizing value of distillery waste was in any way comparable with the fertilizing value of molasses. The experiments have shown that distillery waste in Mauritius has a very considerable fertilizing value, but that it is smaller than that of molasses. Bearing in mind the greater attenuation of the wash the results indicate that satisfactory results will probably follow the application of distillery waste to sugar-cane cultivations.

The practical difficulties in handling large quantities of liquid from distilleries is discussed and certain suggestions made.

# BOILED COTTON SEED AS STOCK FOOD.

E. GRAHAM,
*Chief Dairy Expert.*

Owing to the increased attention that is now being given to the growing of cotton by farmers, there is a correspondingly larger amount of cotton seed available each year, as feed for stock, and it is of more than passing importance that simple and inexpensive methods of preparing the cotton seed before use in feeding to stock should be understood generally.

A great deal of valuable information concerning the utilisation of cotton seed for stock-feeding purposes has been supplied by officers of the Queensland Agricultural Department, and the same has been available to dairymen interested, through the medium of the Journal, from time to time. While it is widely recognised that cotton seed is comparatively high in nutriment, as a fodder, it has failed to grow into general use as a feed for dairy stock, partially on account of the difficulty attendant to the removal, by means of crushing or other device, of the hornlike substance of the shell which covers the kernel of the seed. However, as the result of experience which has been gained by the feeding of cotton seed, after boiling, to stock, the indications are that the crushing of the seeds and the removal of the shells are not really imperative.

For some time past it has been the practice of several dairymen to feed boiled cotton seed to the dairy cows, and the results to date go to show that the boiled cotton seed is quite satisfactory for use as a concentrate for feeding in conjunction with other fodders, such as white straw chaff, sorghum, cow-cane, etc.

The method of boiling the seed is as a follows :—Place sufficient of the seed to meet the requirements of the herd for a day in a copper or other receptacle, and add enough water to cover the seed ; then bring to a boil. The boiling should be continued for fifteen to twenty minutes, and by this time it will be found that the shells have been reduced to a sufficiently soft condition to allow of the kernels of the seed being pressed out of the shells with comparative ease. It is noticeable, also, that the shells, by boiling, lose a great deal of their original toughness, and it is highly possible, too, that the shells in this state are more readily digestible.

As the seeds have a tendency to float on water, it is advisable to cover the top of the receptacle in which the boiling is carried out ; when this is done it is unnecessary to stir the seeds during boiling.

If boiled in an open vessel, it is best to press the seeds into the boiling water rather than to stir them, because harsh agitation of the seeds when the shells are softened causes the shells to break and the contents to be lost as feed.

After boiling is completed the superfluous water may be run off, and the seed is then ready for feeding purposes.

The boiled seeds do not ferment readily, consequently ample seed may be boiled at one time to fill the requirements for the day. It is estimated that 2 lb. of the boiled seed is approximately equivalent to 1 lb. of the dry seed.

Animals partaking of the cotton seed are healthy in appearance, and no difficulty is experienced in getting cows to take cotton seed in a boiled form.

—QUEENSLAND AGRIC. JOURN. VOL. XVI, PART 5.

# ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st JANUARY, 1922.

| Province, &c. | Disease. | No. of Cases up to date since Jan. 1st. 1922. | Fresh Cases | Recoveries. | Deaths. | Balance Ill. | No. Shot. |
|---|---|---|---|---|---|---|---|
| Western | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 71 | 71 | 50 | — | 21 | — |
| | Anthrax | — | — | — | — | — | — |
| | Rabies | 1 | 1 | (Destroyed) | | — | — |
| Colombo Municipality | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 101 | 101 | — | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| | Rabies | 2 | 2 | — | — | — | — |
| Cattle Quarantine Station | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 11 | 11 | — | — | — | — |
| | Anthrax | 24 | 24 | — | — | — | — |
| Central | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 1 | 1 | 1 | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| | Piroplasmosis | 6 | 6 | 5 | — | 1 | — |
| Southern | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 6 | 6 | 6 | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| | Hæmorrhagic Septicæmia | 8 | 8 | 2 | 6 | — | — |
| Northern | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 294 | 294 | 294 | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| Eastern | Rinderpest | | Nil | | | | |
| | Foot-and mouth disease | | | | | | |
| | Anthrax | | | | | | |
| North-Western | Rinderpest | | Nil | | | | |
| | Foot-and-mouth disease | | | | | | |
| | Anthrax | | | | | | |
| North-Central | Rinderpest | | Nil | | | | |
| | Foot-and-mouth disease | | | | | | |
| | Anthrax | | | | | | |
| Uva | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 41 | 41 | 3 | — | 38 | — |
| | Anthrax | — | — | — | — | — | — |
| Sabaragamuwa | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 128 | 128 | 91 | — | 37 | — |
| | Anthrax | — | — | — | — | — | — |

G. W. STURGESS,
Government Veterinary Surgeon.

Colombo, 8th February, 1922.

# METEOROLOGICAL.

## JANUARY, 1922.

| Station | Temperature: Mean Daily Shade | Temperature: Difference from Average | Mean Humidity | Mean amount of cloud 0=clear. 10=overcast | Mean Wind Direction during month | Daily Mean Velocity. | Rainfall: Amount | Rainfall: No. of Rainy days | Rainfall: Difference from Average |
|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | % | | | Miles. | Inches | | Inches |
| Colombo Observatory | 80·0 | + 1·0 | 74 | 4·4 | N | 143 | 2·12 | 9 | - 1·30 |
| Puttalam | 77·9 | + 0·5 | 78 | 3·6 | NNE | 139 | 3·89 | 5 | + 1·37 |
| Mannar | 79·2 | + 0·4 | 75 | 5·0 | NE | 191 | 2·73 | 6 | + 0·11 |
| Jaffna | 77·7 | + 0·3 | 80 | 4·6 | NE | 123 | 2·68 | 7 | + 0·38 |
| Trincomalee | 79·0 | + 0·2 | 76 | 6·0 | NE | 196 | 2·44 | 8 | - 3·93 |
| Batticaloa | 78·0 | + 0·2 | 84 | 5·4 | NNE | 236 | 11·34 | 13 | + 1·39 |
| Hambantota | 79·1 | + 0·7 | 78 | 4·2 | NE | 322 | 1·13 | 7 | - 2·22 |
| Galle | 79·1 | + 0·9 | 81 | 5·1 | | 110 | 0·88 | 8 | - 3·45 |
| Ratnapura | 80·7 | + 1·0 | 75 | 5·2 | — | — | 5·81 | 12 | + 0·52 |
| Anu'pura | 76·6 | + 0·1 | 78 | 5·2 | — | — | 1·21 | 7 | - 2·46 |
| Kurunegala | 78·1 | + 0·1 | 74 | 4·1 | — | — | 1·80 | 6 | - 1·65 |
| Kandy | 75·2 | + 0·8 | 75 | 4·0 | — | — | 3·24 | 9 | - 1·78 |
| Badulla | 70·2 | 0 | 83 | 6·6 | — | — | 6·76 | 16 | - 2·82 |
| Diyatalawa | 64·7 | + 0·1 | 85 | 6·0 | — | — | 4·25 | 12 | - 1·80 |
| Hakgala | 57·2 | + 0·2 | 89 | 6·6 | — | — | 5·70 | 9 | - 3·85 |
| N. Eliya | 57·5 | + 0·1 | 78 | 5·2 | — | — | 3·13 | 10 | - 2·46 |

In January 1922, the rainfall over three-quarters of the island was below average and over about a quarter, this deficit was greater than 5 inches. The deficits were most pronounced in the areas where the January average is high. Thus at Rangalla, ST. MARTIN'S and Hendon Estates recorded 27·18 and 23·44 inches respectively but were considerably below their averages which are well over an inch a day for the month. Of the areas where the average was reached the chief were part of the Jaffna Peninsular, the south of the North-Western Province and the northern parts of the Western Province and Sabaragamuwa. Dunedin (12·07 inches with average 5·8 inches) and Yatiyantota (14·25 inches with average 6·7 inches) may be mentioned, but excesses of 2 "above average" were rare, though cases occurred not only in the districts just mentioned but in such varied parts of the island as Ratgam (Padukka), Beauseju (Southern Province), Liyanagahatota and Kalmunai. The last named is particularly noticeable in view of the very general deficit of rain on the east side of the island. As is often the case, a weak monsoon (as judged by rain) on the windward side was associated with an increased number of afternoon hunderstorms on the lee side, notably in the South-West quardrant though the fact has been commented on this month from such central areas as Pussellawa.

As regards distribution in time the 5th—8th, 26th—28th, and the 31st included most of the heavy rain, the number of days on which rain fell being below average at the majority of stations.

The offsets of mean temperature were all slightly above average; and those of humidity in almost all cases slightly below.

The amount of cloudiness was below, rather than above, average and its effect showed clearly in the increased range of daily temperature variation.

Thus at Nuwara Eliya there were repeated frosts in the latter part of the month but the maximum temperature at Colombo on January 26th was 93·1 which is above anything recorded at that station last year, despite the fact that annual maxima at Colombo do not usually occur so early in the year as January.

Air pressure was rather low but its distribution was not abnormal.

A. J. BAMFORD,
Supdt. Observatory.